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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are:—
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Forthcoming Events.

FEBRUARY 17-28.

British Industries Fair:—London and Birmingham.

FEBRUARY 18.

Co-ordinating Committee:—Combined meeting at Dudley. "Pearlitic Cast Iron and Perlit Iron," Paper by H. J. Young.

Institute of British Foundrymen.

FEBRUARY 15.

East Midlands Branch:—Ordinary meeting at Derby. "The Physical Properties of Foundry Coke," Paper by Prof. H. V. A. Briscoe, B.Sc.

FEBRUARY 20.

London Section:—Ordinary meeting. "Welding of Cast Iron," Paper by W. Steel.

FEBRUARY 22.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Mass Production from Cheap Plant," Paper by L. Wharton.

Home Office Regulations.

We have just received a review copy of "Memorandum on Chains and Other Lifting Appliances,"* and have nothing but praise for its contents. Being a Government publication, it obviously takes care to remind one of the Home Office Regulations in this connection. Actually, however, the object of the book is the cause and possibility of eliminating accidents arising from the failure of lifting tackle, embraced by chains, rings, hooks, shackles and swivels. The book treats the subject in a very rational way, and the observance by foundries of the tenets it exposes will make for safe and orderly work. We have been attacked in the past for giving our blessing to certain Home Office Regulations on the ground that they impose hardships on the larger establishments, as the smaller ones ignore them, whilst foreign competitors do not have them. We have been in a position to follow the effect of the Home Office Regulations as to dust removal from sand-blast apparatus and grinding machines. We are unrepentant that we supported these, as we have seen real economies result from their common-sense application. Actually, well-designed plant complying with the full Home Office Regulations can be installed so as to fit in with continuous working processes, and in such a manner as to reduce handling costs to such an extent that economies result. So far as "Chain Regulations" are concerned it is obvious that damaged moulds, patterns or spilt metal can lose more money per annum than it costs to comply with the regulations.

We remember that some foundries objected to the whitewashing of walls regulations; yet again the lowering of the bill for artificial illumination may contribute a considerable quota towards paying for its cost.

* Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 2s. net.

The general ground for attack upon us, when we favour certain Home Office Regulations, is that he who pays the piper calls the tune. Our answer is that, if we judge the tune a good one, it is well within our province to suggest that the piper's effort is well worth support. Some of the proposed legislation, however, certainly cannot command the support of any one who has had serious experience in works management.

The New Educational Scheme.

We have already referred in broad outline to the new proposals for foundry education, but so much interest has been displayed in the matter and it is recognised to be one of such vital importance to the trade, that we propose to deal with the subject in rather more detail. It is hoped that the inauguration of the new course of action will result in the establishment of educational machinery on a parallel with that in process of inauguration in other trades. No one is likely to disagree with the proposition that such machinery is at least as necessary to founding as to grocery, building, gas-fitting or plumbing.

During the past few years there has been a very marked change in the attitude of the Board of Education and of the local education authorities towards industry, in that they are now keenly anxious to obtain the co-operation of the industry in working out such a scheme as may consider actual practical needs in the arrangement of its courses. Another change has been in the direction of making certain educational developments national in character, rather than an affair to be dealt with by local authorities not necessarily acting in co-operation or consultation with one another. Existing standards, it is well known, differ widely from one area to another. The new developments, however, would tend to make it possible for an equally high standard in such education to be obtained in any part of the country, a consideration which is of special importance when we remember how widespread the foundry trade actually is.

The greater number of workers in the industry will be concerned to see that there is some recognition for the apprentice who is the skilled artisan of the future. The new scheme would, broadly speaking, make it possible for the would-be patternmaker, moulder or coremaker voluntarily to attend classes for two or three evenings a week for two or three years from the age of sixteen. At the end of this period there would probably be a brief written examination accompanied by a written test. The written examination would be conducted by the City and Guilds of London Institute, the examiners being appointed by an advisory committee of the Institute. This committee would contain the nominees of various interested bodies, but more particularly the nominees of the Institute of British Foundrymen, which would thus have a direct connection with, and influence upon, the young people going into the industry. This would, of course, fall into line with the generally accepted modern view, which invests the professional bodies with the care of their young people's education. The practical test would be

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arranged on a local basis, and it would be supervised by judges appointed by the advisory committee. The ultimate result of such a scheme would be that every boy employed in a foundry with an intention of taking up the trade would —or could—have a definite certificate of his ability. There can be no question as to the suitability of the City and Guilds of London Institute for the control of these examinations. It is a body with an old and distinguished history in the conduct of craft examinations, and it has been chosen by the Board of Education to make a speciality of this kind of work in future. At a later date we propose to discuss the remainder of the new scheme.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

High-Duty Iron.

To the Editor of The Foundry Trade Journal.

Sir,—Referring to the article in the Journal, January 23, under the heading of "High-Duty Cast Irons," I was pleased to notice the writer calls the special attention of ironfounders to the importance of their giving encouragement to engineers and others by producing for their benefit heat-resisting, stronger and more durable castings than those now being offered under ordinary conditions; I have been associated with a founder who has taken more than a passive interest in this particular subject and has been carrying out the suggestion with a considerable measure of success.

Firebars and mortar-pan bottoms have been put in which have not only lasted much longer than those previously supplied made from the ordinary iron, and in the case of the firebars less clinker is formed on the surface exposed to the fire, so that from the engineer's standpoint they are more economical and less costly. Engineers' castings have also received special attention and are now being made stronger and more durable than formerly, as suggested by Mr. McRae Smith.—Yours, etc.,

C. Shardlow.

2, Elm's Road,
Stoneygate, Leicester.
February 3, 1930.

Foundry Education.

To the Editor of The Foundry Trade Journal.

Sir,—I read with interest and much feeling your leader headed "An Educational Metamorphosis" that appeared in the Journal on January 30, 1930.

I feel quite sure that in my following remarks I am voicing the opinion of many more. We have all read from time to time articles and letters concerning the serious problem, foundry education for the students and trade apprentices. I regret, however, the student element is practically nil; the reason for this is, or at any rate the part reason, there is no recognised examination. As regards the apprentice examinations, I consider myself as one of the pioneers in this matter, inasmuch as it was through my effort that the E.M.E.U. set examinations in their area for the first time in 1927, the subjects being theoretical and practical foundry work. So far so good for the trade apprentice, but as a class of engineers and the person, let him be called the foundry manager, is as much an engineer, and in many cases to my knowledge, far more so than men who call themselves engineers, the difference being, or one of them, is that they have an institute, and to become a member they must pass an examination which entitles them to be known as engineers, whereas the poor old slow foundryman can become a member of his institute by paying a fee. The matter is made worse by the fact that a member may not even be a foundryman. I have been actively engaged in the foundry for the past 15 years, but I refuse to become a member of any institute having no entrance examination.

We must get students interested in our work, and we shall never do it until there is a final recognised examination entitling them to show the world what they are. It is not necessary for me to show here the many advantages such an organisation has; it is up to those that are in power to move with the matter and do something.—Yours, etc.,

J. H. List,
Engineer and Foundry Manager.
February 11, 1930.

[We would draw our correspondent's attention to the following:—(1) None of the great engineering institutes was created with entrance examinations—they came later; (2) the Institute of British Foundrymen has moved very far in the matter, as is partially disclosed by our leading article; and (3) before examinations can be effective they must be sponsored initially by such bodies as Mr. List disregards.—Editor.]

High-Duty Cast Iron.

Signori A. Mele and G. Calbini, writing in the December issue of "La Metallurgia Italiana" on the subject of "High-Duty Cast Iron," include in their survey Lanz, Emmel, "Sterngass" and duplexing processes of making high-quality castings. They take cognisance of these processes in relation to their influences on the matrix and the graphite formation. Unfortunately, their studies end with the year 1927. They include a table which shows the development of the tensile strength of cast iron from 1870 to that date. It reads as follows:—

Year.	Tons/Sq. In.
1870	7
1887	9.5
1914	14.5
1916	17.0 (Lanz)
1924	20.0 (Emmel)
1925	19 to 22 (Piwowarsky)
1927	24 to 26

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers, in their Statistical Bulletin for December, report that the production of pig-iron in December amounted to 643,000 tons, compared with 631,400 in November and 540,400 tons in December, 1928. The number of furnaces in blast declined by 1 to 162 during the month compared with 132 at the end of December, 1928. The production of pig-iron for the whole year amounted to 7,579,500 tons, which is 969,400 tons higher than in 1928 and the highest post-war production with the exception of 1920. Production of pig-iron is still, however, very much below production in 1913. Table I compares the production of pig-iron in the various districts in 1929 with that of 1928 and 1913.

Steel production in December amounted to 661,200 tons, compared with 815,000 in November and 683,100 tons in December, 1928. The December production brings the total for the year to 9,654,700 tons, compared with 8,519,700 in 1928. Steel production in 1929 was higher than in any previous year except 1917. Table II shows the production of steel in the various districts for 1929 compared with that in 1928 and 1913.

Random Shots.

If you have anything to excuse or apologise for these days, whether it be bankruptcy or a mere inability to pay your Income Tax, the fashionable method is to blame the Hatry affair, or, in more general and more impressive terms, "the recent financial troubles." I cannot help feeling that these troubles have, indeed, acted as scapegoat for many folk whose financial activities go no further than the Post Office Savings Bank, but there, one must be up to date! Nevertheless, it is beyond doubt that the said financial troubles have provided a national stumbling block, if only to the formation of new companies. Remembering some of the harebrained schemes for which public support was invited a year or two ago, I don't feel that this is altogether a pity. The figures, however, are startling. The total capital of new companies registered at Somerset House—I had nearly said Scotland Yard, but I don't want to libel anyone!—last year was the largest since the boom period immediately following the war. But the total was approximately twice as large for the first half of the year as for the second—£152,300,000, as compared with £77,250,000. Such figures need no comment.

* * *

There was an interesting instance recently of what one might call unconscious contribution to a discussion. One of the daily papers has been "stunting" the £10,000 a year man—just by way of a change from the £1,000 a year man, who is so popular a figure in the eyes of the suburban reader. The views of various prominent industrialists and business men have been published, and most of them appear to lament the inadequate and unsuitable preparation of our young people for a commercial life. Whether the solution really lies in cramming them with the jargon and the routine of commerce instead of plunging them direct from school or college into office or factory, I would not be prepared to say. . . .

* * *

But the entertaining part of the thing was this, that a real contribution to the discussion was made, all unconsciously—at least, so I presume—by Mr. Oliver Baldwin, M.P., when he spoke at the annual dinner of the Staffordshire Iron and Steel Institute recently. He inveighed at some length against the habit of preferring members of the family, university graduates and peers of the realm for positions on industrial directorates. Apparently Mr. Baldwin considered this to be one of the outstanding defects of British industry to-day, resulting in an effective limit to the aspirations of the man in the ranks. Maybe; and maybe not. In a highly individualised country like ours it is never safe to generalise. But I have an old-fashioned belief in the ability of water to find its own level. There are, and there always have been, enough examples of the successful self-made Englishman to prove that the really able man will find his way to the top, whatever his origin or his opportunities. All this talk about men worth £1,000 a year, or £10,000 a year, or £100,000 a year for the matter of that, is beside the point. You can't make such men; like Topsy, they just grow.

* * *

Marksman's Bulls' Eyes.

It needed the advent of the motor to teach us how truly the horse is the friend of man.

Bootlegging must be a pretty liquorisky business. . . .

Marksman.

Is Technical Education Worth While to the Foundryman?

The Middlesbrough, Newcastle and District Branches of the Institute of British Foundrymen combined in a visit of inspection to Messrs. Richardsons, Westgarth & Company's Engine Works, Hartlepool, not described in the last issue, and a party of over two hundred spent a very interesting time.

Following the inspection and tea, at the invitation of the firm, the company listened to an instructive address on "Is Technical Education Worth While to the Foundryman?" by Mr. W. H. Meadowcroft, of Burnley.

MR. MEADOWCROFT said: This address is an appeal to the young foundrymen and to moulders generally to realise the benefits of technical education. It is fully recognised that the moulder can be a good craftsman without having any technical knowledge or, indeed, any education at all, but this knowledge is essential to his highest development. Prior to the formation of the Institute of British Foundrymen very little interest was shown by foundrymen in technical education. There was scarcity of written information on foundry work, which was scattered about in various engineering books, and one had to be persistent in search to find it. When the Institute began its work, conditions improved and to-day there is more being written about the various phases of foundry work than one has time fully to read and digest. Almost every week one reads of new theories and discoveries which promise solutions to some of the many difficulties and seeming paradoxes met with daily in the foundry. The changes and improvements made during recent years have been mainly in equipment. Various kinds of labour-saving appliances and machines of every kind are in use, but no serious national attempts have yet been made to educate the working craftsman in the foundry. There are fewer technically-educated men in the foundry than in any other branch of engineering. This is a handicap which must be remedied. It is a difficult task. The average foundryman is most conservative and sticks to the ills he knows rather than venture in the new and, to him, the unknown.

Looking back over a lifetime's work in the foundry one can sympathise with him to some extent and understand his attitude. The speaker entered the foundry at ten years of age as a half-timer—a day at school and the next at work. In the early days, foundries were very different from those to-day. They were generally dark, forbidding places, badly lit, but well ventilated—too much so in wintry weather. Working conditions were rougher and the apprentice moulder was kept at his job more ruthlessly than he is to-day. It is said sometimes that we are the better for it, but this is doubtful. The speaker's chief job for the first twelve months was smuggling liquid refreshment for the moulders; he could still feel the heavy hand of one of the moulders who deemed it his duty to go round and clout all the boys at nine o'clock every morning. The moulders were a rough class of men, independent, proud of their skill, always ready for a day's holiday or away on the road. Yet they did good work, much of it done under the worst conditions. Jobbing shops are still prevalent to-day in Lancashire and the West Riding. Most of them, unfortunately, have a very lean time, for there is more worry than money in them. These old types are fast disappearing, and foundries dealing with a limited range of work are taking their place to meet the demand of the engineer for high-class castings. Bearing in mind the development of the foundry which has been haphazard and casual, we can realise the effect it has had on the traditions of the trade, and it is reflected in the views held by moulders generally on the other departments of the engineering trade. The moulder works with materials of uncertain composition, which increase the natural risks inherent to the trade, and in doing his best according to his intuitive skill and experience, when he meets with failure, he feels the lack of sympathy and help which is needed at such times. It has been said that moulding would be all right if they had not to cast. A worried foundry owner once wrote to Thomas West asking if it was possible to tell when a mould was truly made. Wests' answer was brief and conclusive. He said, "Yes; cast it." The isolation of the foundry from the other departments of engineering has been a great barrier to foundry development. Up till quite recently, moulders took very little part in general engineering development, and took little interest in the social development of the trade. Happily this is rapidly passing away. The Institute has widened the outlook of the foundryman, and the Foremen's Mutual Benefit Society has done wonderful work in breaking down the barriers between different departments. This is of great benefit to the whole trade; old prejudices break down slowly, but one thing is quite plain to all thinking foundrymen, and that is that all must concentrate their energies on the task of bringing the foundries into line and do their utmost to solve the difficulties and shortcomings of the moment. To do this trained and alert minds are necessary to take advantage of the great stream of discoveries and inventions which flows in from every side. Technical education of the foundryman is more than worth while; it is imperative that he should try to master the principles that lead to successful work. To obtain satisfactory work there must be intelligent skilled moulders and core-makers. No branch of engineering exists where skill, patience and technical training give better results than in the foundry. Even to-day there are those who say a moulder needs no schooling. They are mistaken, and could be ignored but for the harm they do to the young and inexperienced. The cardinal point is that every apprentice should strive to be a good craftsman and neglect no opportunity of gaining all the practice and knowledge available in the shop. This, together with a full technical training at the local college, will make him a better moulder. In every industry except the foundry it is taken as a matter of course that apprentices attend certain day or evening classes in connection with their particular trade. Why should the moulder be exempt? One has only to look at foundry equipment in general to realise how the foundryman of the past and to some extent of the present has been handicapped owing to lack of technical knowledge. Moulding-boxes of bad design, excessive weight, rough joint edges, badly-fitting pins, shortage of lugs for securing the boxes, which means improvising clamps, etc., to make the job safe—this all means additional work for the moulder. A trained engineer would design something more suitable and accurate in fit with machined joints. Of course, it would mean a greater first cost, but it pays for itself, whilst removing some of the risk and uncertainty of the job. Even a water-tank has flanged joints bracketed with bolt holes 6 in. pitch. The moulding-box has more sudden stresses to stand than the tank, with less provision to withstand them. And so one could go on quoting similar illustrations. The evil is that the moulder takes this as a matter of course. To make good castings it must needs be "Science Hand in Hand with Labour." When a good casting is made the correct methods must have been used, no matter how one has acquired the skill and knowledge. When there is a waster, founders are busy wondering what part of the job was wrong. It is here that technical knowledge is helpful. The more one understands the raw materials used, the less likely is one to make mistakes when using them in the foundry. This knowledge gives an added interest to one's daily work. The sciences are largely called upon to solve and explain moulding and casting problems.

Here is a moulder's course (first year), which will make the unthinking moulder realise the need for solutions of the many problems met with day by day.

Moulders' Course: First Year.

Monday night (7—9).—Mathematics and drawing.

Thursday (7—9).—Practical work in a local foundry. Simple moulding and core-making, with examples of explanations. Weekly survey of work in progress at the foundry.

Friday (7—9).—Lectures, demonstrations, etc., on foundry processes and materials. Eleven students in these classes.

The foundry is an integral part of engineering, and the old idea that it is a place for misfits must go. The art of moulding calls for skill and intelligence equal to any other branch of engineering. Many old moulders were great craftsmen not too well paid for their work, but they achieved satisfaction in making good castings. Our task, then, is to guide and help the rising generation of foundrymen to a technical training suitable for the needs and demands of the future. Knowledge is power. The foundryman of the future, technically trained, will take his rightful place and will no longer suffer from any inferiority complex. His studies will bring greater self-respect and a new and wider outlook on life. The speaker has been impressed with the progress made by the foundry students at his local classes in Burnley. Classes are held for foundry students, and these have been very successful. Three classes are held three nights a week, one night being spent in practical work in the local foundries. Many of the boys travel six to eight miles. The classes are under the supervision of the Burnley Section of the Institute, which does its utmost to encourage the students, whose ages extend from 16 to 26. The fight is a hard one, and results seem slow. The foundryman will have to make special efforts to get a good simple system of training foundry students. Most of the people in charge of the various training centres frankly admit that they know very little about foundry work, but they are anxious to know the best way to cater for foundry students. This is the task of the Branch members; to state their needs and help to arrange suitable classes for the different districts. The members are impressed with the importance of this question of technical training for foundrymen, especially at the present time, when this country is struggling to free itself from distress, partly due to the war and partly to violent changes in economic conditions. It is of great importance that foundrymen use every effort to bring their craft to its highest efficiency. They will be better and more useful citizens as they become better craftsmen. Study and practice will give them greater knowledge of materials, develop their imagination and technical skill. Perseverance is wanted, love of the work itself, sympathy with the use that is to be made of it and with the user.

Publication Received.

Price Chart.—We have received from Vivian Younger & Bond, Limited, Princes House, 8, Basinghall Street, London, E.C.2, a chart covering the prices of pig-iron, copper, tin, spelter and standard silver at the 1st of each month for the last 20 years. The value of such a chart is enhanced by its size, which in this case is about 4 × 3 ft.

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Present Position of Chromium Plating.

RECENT DISCUSSION IN LONDON.

At a meeting of the Electroplaters' and Depositors' Technical Society, held at the Northampton Institute, London, on January 31, a general discussion took place on "The Present Position of Chromium Plating." Dr. R. S. Hutton (President of the Society) was in the chair.

Mr. G. E. Gardom, who opened the discussion, said that chromium plating was most satisfactorily carried out from a solution containing 250 grammes of chromic acid per litre—about 2½ lbs. per gall.—with a quantity of sulphuric acid which would give a ratio of chromic to sulphuric acid of 100 to 1, *i.e.*, 2.5 grammes of sulphuric acid per litre. The ratio between chromic and sulphuric acid was more important than the actual concentration of the solution. Lead anodes should be used having the largest possible area. It was desirable to use a current density of about 200 amps. per sq. ft., and the solution should be at a temperature of about 150 deg. Fah. to obtain a bright deposit. Also it had become the practice to chromium plate over nickel rather than copper, since nickel resisted corrosion better than a copper under-coat. There were certain advantages in using a more concentrated bath than that indicated, viz., 500 or 600 grammes of chromic acid per litre, with a suitable quantity of sulphuric acid to give the 100 to 1 ratio, and among these advantages was the considerably lower temperature at which bright deposits could be obtained. The cost of maintaining a large open tank of solution across the surface of which a large volume of cold air was being drawn was very much increased with the temperature difference between the solution and the air temperature, and with the more concentrated solution it was possible to work at 40 deg. C. instead of 50 deg. C.

Current Density and Lustre.

A further advantage of a lower temperature was the ability to work with a lower current density and obtain bright deposits. Still further advantages were lower evaporation losses, smaller proportionate changes in concentration after deposition of chromium, and possibly a slightly wider range of current densities within which bright deposits could be obtained. Against these advantages were the higher capital expenditure on the solution with which was bound up a greater loss of solution. The advantage of using lead anodes was due to the formation of a coating of lead peroxide, which acted as a true insoluble anode. Moreover, a greater proportion of the chromic acid was reoxidised when using lead anodes than was the case with anodes of iron or other substances. On the other hand, lead anodes tended to form adhering and badly-conducting films of lead chromate, especially when the bath was not in use. Alloys of lead and antimony—using antimony to the extent of 6 per cent.—were claimed to overcome this difficulty to some extent, but the ideal alloy for this purpose had yet to be found, and anode film formation remained a serious worry to the chromium plater. The use of 6 per cent. antimonial lead had been adopted in America, and it would be interesting to know if it had been used in this country yet.

Co-operative Research.

Speaking of the need for co-operative-research work on chromium plating in this country, Mr. Gardom mentioned that the American Electroplaters' Society some years ago established a research fund and arranged a programme, part of which was already in hand. This programme included (1) the principles of chromium plating; (2) conditions and methods of chromium plating; (3) control of chromium plating, including health hazard; and (4) the properties of electrolytic chromium. The Bureau of Standards at Washington had issued a pamphlet on the health hazard, and an important inquiry was in progress concerning the throwing power of chromium plating. The throwing power was undoubtedly poor, and in an interim report on this matter the Bureau of Standards suggested (1) that a high-chromium-acid content increased conductivity, but reduced throwing power; (2) that an increase in the chromic-sulphuric-acid ratio to 200 to 1 increased throwing power; (3) neither boric acid nor sodium chromate had any effect on throwing power; (4) increase of temperature with the same current density lowered throwing power; and (5) an increase of current density at the same temperature increased throwing power.

It appeared, therefore, that maximum throwing power was obtained at high temperatures and high-current densities. The Bureau of Standards also stated that 250 grammes of chromic acid per litre and 1.25 grammes of sulphuric acid gave a bright deposit, which was about half the sulphuric acid previously mentioned. The temperature suggested was 55 deg. C., and the current density 280 amps. per sq. ft. This required 8 volts, but, as that was not always available, it was suggested by the Bureau that by using 6 volts with 400 grammes of chromic acid per litre and 2 grammes of sulphuric acid per litre, with a temperature of 35 deg. C. and 56 amps. per sq. ft., good results would be obtained, but not so good as with the higher temperature and current density.

Continuing, Mr. Gardom said that current distribution should be as uniform as possible, and, with this object in view, the anodes should be arranged round the cathode as far away as possible, from 12 to 18 in. Copper-coated anodes had also been found to improve the throwing power. The difficulty in commercial chromium was to obtain nickel for the undercoat which would not strip or blister. From this point of view the present methods of polishing prior to nickel-plating were unsatisfactory, although some recent work was of a very high order.

Chief Defects of Chromium Plating.

Mr. A. D. Weill said the most important advance in connection with chromium plating during the past year or two appeared to be the realisation of some of the defects of chromium deposits, the principal being porosity, and the tendency of the deposit to develop hair-line cracks on attaining any appreciable thickness. These were responsible for the early disappointment with regard to chromium as a rust preventative. These troubles led to a search for a suitable under-coating, and, although copper proved to be quite suitable from many points of view, it had its drawbacks, and nickel had since been adopted as the standard under-coat. Two facts of importance, however, must be studied in depositing nickel prior to chromium plating if peeling or lifting of the nickel was to be avoided. One was the production of a soft deposit free from stresses, and the other was the perfect adhesion of the nickel coating. The softness of the deposit was largely influenced by the composition, temperature and acidity of the nickel bath. Generally speaking, the ordinary type of cold nickel solution containing double-nickel salts was unsuitable; warm nickel-salt baths operated at 90 to 100 deg. Fah., with an average pH of 5.8 to 6, appeared to give the best results. Deposits of half an hour's duration in this type of bath were usually found sufficient.

Poor Adhesion of Nickel.

Regarding adhesion of the nickel, there had been considerable disappointment, and careful attention to cleaning and neutralisation of cleaning solutions occluded in the pores of the metal was essential. It was also useful to provide a bonding surface for the subsequent nickel deposit by means of slightly etching the surface of the work, but without impairing more than necessary the lustre of the surface. Discussing the many practical problems with which the chromium plater was faced, it was remarked that poor throwing power was undoubtedly the chief trouble, and, therefore, great care must be taken to arrange the anodes and the work in such a manner as to obtain, if possible, equal current densities on all parts of the article. The importance of stout and good connection was also emphasised. Flat copper bars 1 in. by ¼ in. were recommended as particularly useful, as they could be fitted with spring clips for gripping the interior of small articles. Again, the use of rubber-insulating tape would be found serviceable, as bound round the suspension hook near the point of contact with the work it obviated the generation of troublesome gas at this point.

Temperature Control.

Continuing, the speaker said careful attention must be paid to the control of temperature and current density. It could be taken as a rough guide that an average temperature of 115 to 120 deg. Fah. will enable bright deposits to be obtained within the range of 120 to 200 amps. per sq. ft. Finally, speaking of the health hazard to workers, it was mentioned that the United States specifications call for an air velocity of 2,000 ft. per min. at the mouth of the exhaust duct, and this figure had been found quite suitable to work upon; but the current to be continually passed through the bath was also of great importance, as obviously the volume of spray generated in two plating tanks of exactly the same size was quite different where one was being used for small work and the other for large. The lining of plating tanks with sheet glass had proved most advantageous, much saving having been effected in the leakage of current by this method.

Effect of Varying Thickness of Deposit.

Mr. J. G. Roberts said that he had tried varying the conditions, working on a large scale, but had found nothing that was an improvement on the straight simple chromic acid and sulphuric-acid solution. Regarding the film on the anodes that had been referred to, he found that, working on a large scale, that it was more economical in the end to use a little more current to overcome the effect of this film than to worry about removing the anodes from the solution in order to clean them. He was speaking of working with 10-ft. vats. Again, he had never seen anything in the way of patchy deposit, and again that might be due to the fact that he was working with large vats. There were, however, some curious things with regard to chromium plating which had to be watched if the best results were to be obtained, such as the manner in which the articles were put into the vats, the time they were left in, the current density, temperature and so on. One point not mentioned so far was that if the work was left in the vat too long the deposit was of a dull colour. The thicker the deposit the duller the colour. He would like to hear more about nickel adhesion, because that was a definite trouble at the moment. He had found that much trouble with chromium plating was due to faulty cleaning before putting the work into the bath.

Mr. E. A. Ollard said that, although modern chromium plating was very much better than it was five years ago, it was extremely difficult to say in what way the improvement had been brought about. There was practically no difference in the methods adopted, and he personally felt that the improvement was due to a greater knowledge of the details. There were such matters as the purity of the chromic acid, which was far from satisfactory in the early days, the difference in the perfection of the apparatus and the exhaust appliances, etc. Again, there had been a great improvement in manipulative skill. As to adhesion of nickel, he did not see why there should be any trouble if care was taken. He believed the best nickel solution for giving a hard deposit was 3 lbs. of nickel sulphate per gallon with a little boric acid, a little chloride and a little sodium fluoride. Using such a solution at, say 25 to 30 deg. C., would give a fairly high pH—about 5.8—and, taking the necessary precautions as to cleaning and putting the work into the nickel bath immediately after cleaning, there was no reason why there should be any peeling. One thing necessary, however, for satisfactory chromium plating was research into methods for avoiding cracks appearing in the chromium deposits.

Cadmium as an Undercoat.

Mr. Leslie Wright expressed regret that, whilst research workers had been helping the practical chromium plater by making known the results of their researches, the practical men did not seem so willing to come forward with the results of their practical experience. He suggested that some care should be taken in regard to the American literature on the subject, because, although it had been stated that better results could be obtained with a 200 to 1 ratio of chromic to sulphuric acid, the American patents on the subject did not seem to bear that out. He asked if anybody had tried cadmium as an undercoat, and expressed the belief that we are no nearer a solution of the fundamental problems of chromium plating than was the case five years ago. Merely to maintain a constant electrode distance, constant temperature and constant current density was not sufficient to obtain the best results.

Mr. Gardom, in bringing the discussion to a close, supported the request that practical workers should publish their experiences more fully than they did. A great deal of progress had been made in this country of which very little was known. The Americans published a great deal more in this way than we did, with the result that the impression was given that more progress was being made in the United States than in this country. A point in connection with the health hazard was that if there were suitable exhausting apparatus there was not much trouble.

Boronising Aluminium Alloys.

RECENT INVENTION COMMENDED.

This new development created widespread interest when it was introduced to the Lancashire Branch of the Institute of British Foundrymen by Mr. N. C. Ashton under the title of "Some Developments in Aluminium Metallurgy." It was printed in our last issue, and the discussion served to emphasise the advantages postulated therein.

Permanency of Modification.

The discussion was opened by MR. A. HOPWOOD. He said he had always understood one point about modified aluminium alloys was that on remelting, the modified structure disappeared; but apparently by the method of treatment Mr. Ashton described, the beneficial effect of modification remained even if the remelting operation was performed ten to twelve times. In the usual run of the zinc-aluminium alloys the trouble was the breaking down of the alloy in service, in some cases being reduced to powder. He would like to ask Mr. Ashton whether the modified Cindal alloys were affected in this way. Did the modification prevent that breaking down?

MR. ASHTON said one of the principal difficulties had been that zinc alloys were very sensitive to impurities. If the impurities were removed one could have alloys which were extremely strong. That was characteristic of the Cindal alloys. There was no fear of disintegration. The Cindal alloys also gave by far the best resistance to corrosion.

In Diesel Engine Practice.

MR. J. MASTERS said the author had not dealt with the reaction which took place in these alloys. Take Diesel engine heads, where in most cases weight was the principal factor. What would be the reaction or after effect on these alloys? The castings he had in mind were for motor launches or for ships.

MR. ASHTON said with the Diesel engine heads the temperatures obtained were 400 deg. C., perhaps higher—almost red heat. With all the usual aluminium alloys the difficulty generally was that the metal became hot-short and broke up, but he did not anticipate there would be any difficulty in this case. The metal itself was a good conductor of heat, and was so strong that one could decrease the section, and again increase the conductivity, so he did not envisage any difficulty would be experienced with Diesel engine heads.

Influence of Melting Practice.

MR. H. MILNER asked the author if a modified aluminium alloy could be used as a "hardener" for subsequent melting and alloying with pure aluminium. Would the modified alloy retain the advantages of modification, and so improve the melt, or would it revert back to its unmodified structure, and thus render the whole melt requiring to be modified?

Mr. Ashton had shown lantern slides of metal cast from a high-frequency induction furnace of the Ajax Northrop type. In this type of furnace there are mechanical forces acting on the liquid bath, which will cause it to bubble up at the middle and flow outwards and down at the sides. As this action was the same as a continual stirring, which was detrimental to aluminium alloys, were alloys melted in a high-frequency furnace in greater need of modification than those melted in, say, an iron pot, suitably dressed?

Continuing, Mr. Miller said he had made some castings in an alloy of 92 per cent. aluminium and 8 per cent. copper, and, whilst the main castings, although cored-out and of thin section and weighing about 60 to 70 lbs. each, were cast free from pinholes, the smaller but more solid parts of the job, cast from the same alloy and weighing only a pound or two, showed pin-holing when machined. Was there, he asked, in Mr. Ashton's opinion, any connection between the volume of the job and the surface exposed to the mould, as regards the extent to which gases released from the sand would be caught in the solidifying metal?

Finally he asked Mr. Ashton if he considered modification an operation which could be carried out in the average foundry, using ordinary crucibles.

Analogies with Iron Foundries.

MR. ASHTON said the boronised alloys formed hardeners in themselves. Remelting in the way they adopted themselves (50 per cent. alloy and 50 per cent. scrap) reduced the grain size. In the high-frequency type of furnace the stirring of the aluminium was a difficulty, because it increased the possibility of dissolving gases, and from that point of view it was unsuitable. He took it the metal for the small castings mentioned by Mr. Milner was melted in a separate pot with smaller scrap pieces, and possibly was kept standing for a considerable time, and picked up a larger amount of gas than would be taken up by the metal from which the larger casting was made.

With the unrefined alloys there was also a danger of spotting being caused by contraction cavities in the metal. These could be explained by the primary crystals overhanging and the still liquid metal drawing away, thus leaving a small cavity. This was more likely to happen if the freezing range of the alloy had been extended owing to the presence of impurities.

Just as happened in an iron foundry, they used different types of alloys for different thicknesses of jobs. There were three grades—thin, medium and thick. For a thin job an alloy which ran freely would be used; for a thicker job a different alloy would be chosen. He emphasised the point that the chief advantages gained by the use of these alloys were that almost any job could be done with them, and that a great saving was affected because no scrap castings were made that could be attributed to gassed metal.

Use of Chills.

MR. MASTERS said that from the economic point of view would not it have been beneficial to use chills for the heavy sectional castings?

MR. ASHTON, in reply, quoted from his paper. "The remedy for this is obvious, but it requires a great deal more foundry skill," etc. One could therefore see that there were often instances where chills had to be used, and indeed their proper use was part of the skill mentioned.

MR. A. SUTCLIFFE asked whether Mr. Ashton suggested that there would not be so much waste metal in heads and risers. If so, there was a great use for these alloys. He had in mind a foundry in the Midlands where he saw a motor engine casing. The amount of metal in the ladle was 2½ cwts., and the casting was only 108 lbs. In a Lancashire foundry the foreman told him there was 2 cwts. of metal in the ladle, and the casting—of the same kind as the one previously mentioned—weighed only 102 lbs. or thereabouts. Mr. Ashton had spoken of casting jobs with different thicknesses of metal—¼ in., ¾ in., 1 in. He (Mr. Sutcliffe) said chilling castings brought the whole mould to one setting point, *i.e.*, ¼ in., no chill; ¾ in., a thin chill, such as a piece of file; 1 in., a thicker piece of chill, and so on.

Mr. Ashton had shown a head of a casting polished. If they could see the 4 in. below the head other conditions might prevail.

Freezing Range and Solid Castings.

MR. HOPWOOD said with these alloys one would have to use perhaps more risers or denseners, owing to the alloy being internally sounder and the very much shorter freezing range over the ordinary alloys. Often a considerable percentage of the aluminium castings sent to the machine shop were rejected because there were pinholes sometimes in patches as large as a penny, sometimes of lesser size. He had seen castings weighing 36 lbs. (and a 36-lb. aluminium casting was a bulky one), returned on account of one pinhole. With the sounder metal obtained with the use of these alloys the castings would not suffer from these gasholes. The point which had been in his mind was that on remelting these alloys no further modification was required. It was possible to have 10 or 12 remeltings of the boronised metal.

MR. ASHTON said no claim was made for decreased shrinkage, but rather that the metal itself had better feeding qualities; the freezing range was shorter and it set quicker, therefore it was much better in feeding. One could not get rid of the contraction in aluminium because it is perfectly natural. It contracted up to 3 per cent. The presence of impurities extended the freezing range.

Experience of Users.

MR. REYNOLDS stated the experience of his firm with these alloys. They had the trouble which practically everybody had with aluminium caused by cracking and speckly metal. The Cindal alloys gave almost complete freedom from cracking—as much freedom as was possible—because the metal was not hot-short. Also the metal was much cleaner, harder and stronger. He had known 50 per cent. of aluminium castings on one job to be thrown out. On the other hand, in the same job, after adopting the Cindal alloys, there was only one casting rejected out of 650. Those castings were machined all over, the machining costing much more than the casting. Apart from the question of corrosion, the great benefits derived from the use of the alloys were the freedom from cracking and the freedom from speckly metal, with consequent losses after machining. They did not look for a saving of metal in the runners and risers. After all, that was a small matter in comparison with the gain in the other direction.

MR. EVANS remarked that his firm had used the Cindal alloys with success. They used the same runners as would be used for cast iron.

Runners and Risers.

The BRANCH-PRESIDENT (Mr. E. Longden) suggested it would be interesting information if Mr. Ashton would tell them the minimum amount of modified alloy necessary to keep the returned scrap and head metal up to the required condition.

MR. ASHTON replied that 40 per cent. would easily keep the metal up to the required condition. With regard to Mr. Sutcliffe's point, it was not easy to draw a definite line in considering the practice in different foundries. It seemed to him Mr. Sutcliffe was expecting something which was impossible to happen, and he pointed out that with steel ingots the heads could be as much as 40 per cent. of ingot. Aluminium was as bad as steel in that respect.

The BRANCH-PRESIDENT asked whether it was not possible that the saving through using the modifying alloy was because with ordinary aluminium there is a great deal of loss due to oxidation, and small scrap must often be sold to metal refiners at a much reduced price?

MR. ASHTON said that undoubtedly with the boronised alloys one had 50 per cent. decrease in the loss, simply because one obtained much better control. He did not think one would get half per cent. of metal loss in melting.

MR. SUTCLIFFE asked for the proper melting temperature of the Cindal alloys for casting jobs; and, in reply, MR. ASHTON stated that it varied from 600 to 680 deg. C., according to

the alloy. In most instances the thinner the job the lower the temperature. There were three different grades of alloys, thin, medium and thick. If one could feed properly there is not so much need for chills or denseners in boronised alloys, in order to produce a strong, sound casting.

The BRANCH-PRESIDENT suggested that if one hastened the rate of cooling in the mould by denseners, or if the alloy had a shorter freezing range, it possibly reduced the head of metal. One would require a larger head of metal to feed over a slower rate of cooling.

MR. ASHTON remarked that there was a saving not only in the avoidance of scrap but also in the castings themselves, due to the fact that the alloy was much stronger, both in the mould and as a casting; it was possible to decrease the heavy sections so as to obtain more even cooling in the different parts of the mould.

Worn Iron Melting Pots and Gas Evolution.

MR. MASTERS said he had seen aluminium castings which weighed 200 and upwards, and were perfectly sound with less than 50 lbs. returned metal. When he was making aluminium castings himself his practice was to use a chill, but he never increased the runners and risers. His contention was that the more metal one poured into a mould the higher he took the freezing range, often more than was wanted. Mr. Sutcliffe had raised a very moot point which was worth while discussing. Ingot suppliers would gain through being able to put upon the market a product which gave a definite setting under different conditions.

A firm he knew cast 12 tons of aluminium a day. They used cast-iron pots, which were open to the atmosphere and were ranged in batches down the foundry. Those pots appeared to deteriorate after a period, and began to evolve detrimental gases, which were occluded in the metal. That was attributed to the pots wearing. Quite good service was obtained from the pots up to that period. Had Mr. Ashton any experience with regard to the comparative cost of melting with oil furnace, graphite pots and cast-iron pots?

Metallurgical Aspect.

MR. J. S. GLEN PRIMROSE said it seemed to him the secret of the success of these alloys was that they produced a proper micro-structure, which persisted. The modification was permanent. It was a remarkable result of the research work which had been carried out, and was a very definite advance in the method of treating aluminium alloys, because that effect was got without the careful technical control required by the ordinary patented methods of "modification," which had only a temporary effect. It was a very great advantage for the ordinary founder to have something by which he could purify his secondary metal and scrap metal and get remarkable results in regard to the strength and toughness. In some cases he could double the tensile strength and go up to 50 per cent. more elongation and have a sound, reliable aluminium alloy. What had been only a dream before had now been achieved, and thanks were due to Mr. Ashton and to his firm for bringing before the members the results of their experience. The members could go back to their foundries and practice what they had learned. Their degree of success would no doubt vary according to their technical skill, but they had now something which would help them to produce castings with a greater degree of certainty than before and with fewer wasters. They had now a knowledge of the proper constitution of the aluminium alloy in general use.

MR. ASHTON, replying to Mr. Masters, said if one could obtain cast-iron pots to give a good life, they became the best proposition. His firm used cast-iron pots for melting in large quantities, with a thin wash of refractory on the inside. With suitable material "spalling" off could be prevented. Oil firing could be worked satisfactorily. Graphite pots were not to be recommended, since they gave carbide to the metal, and also allowed the passage of furnace gas more easily. Carborundum pots were an advantage. Unfortunately he could not give any idea of the comparative cost of these methods, except that they found an electric resistance furnace could be worked much cheaper than gas-firing, when used on routine production.

The whole thing, as explained, boiled down to a question of grain size and the absence of impurities. When no impurities were present the grain size was increased, and it was then necessary to control this. Boronising by the methods used was the only way so far discovered to bring out the useful properties of the alloys, and to make better castings more often.

Open-Hearth Steel.

A report on the results of investigations as to the relative advantages and disadvantages of charging cold and hot pig-iron into open-hearth furnaces is published by DR. ERICH KILLING, of Bobrek (Upper Silesia) in a recent issue of "Stahl und Eisen." The research work was begun at the Julienhütte of the United Upper Silesian Iron and Steel Works, but six other Upper Silesian works were also included later in the investigations.

The results of these investigations may be summarised as follows: (1) The output in tons per hour was larger when molten pig-iron was charged. With a hot-charge the most favourable output was obtained when the charge was about 35 per cent., and with cold charging with a charge of about 19 per cent. pig-iron and the rest rail scrap in both cases. (2) The ore consumption was less with cold than with hot charging. (3) With hot charging the quantity of slag was greater throughout. (4) The iron content of the slag was higher with hot than with cold charging, and the average loss of iron must consequently have been greater with the former. (5) A metallurgical heat balance, however, did not disclose any basis for the most favourable results obtained as above. (6) In regard to cost, the hot process was greatly superior to the cold process up to about 62 per cent. pig-iron, at which point costs became equal. (7) The maximum economy of the two processes can be determined only by comparing the price-difference curves for loss of iron and output in tons per hour, with the difference in cost between scrap and pig-iron. Further investigation will be necessary, however, to determine the influence of cold and hot charging on the quality of the steel produced.

The results show, therefore, that notwithstanding greater loss of iron and greater ore consumption, hot charging is much more advantageous than cold charging. It remains to be ascertained whether with a lower phosphorus content in the pig-iron the excessive amount of slag and consequent loss of iron incidental to the hot charge cannot be reduced to those obtained with cold charging.

IN AN EXHAUSTIVE REVIEW of the iron and steel trades in 1929, Messrs. William Jacks & Company state that here and there small advances have been recorded during the past year, but the iron and steel industry of Great Britain is still a depressed industry. The output of both pig-iron and of steel ingots shows an improvement on the 1928 figures, but the export trade has not materially developed, our imports are on a heavier scale than those of any other country in the world, and broadly it may be said that in the markets abroad our manufacturers have made no real progress against the competition of Continental producers. Whilst the world's consumption of iron and steel continues steadily to increase, and seems likely so to continue, British manufacturers generally have failed to share in that expansion.

Failure of Steel Castings and Forgings.

At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at Newcastle-upon-Tyne on January 24, MR. ROBERT A. MACGREGOR read a Paper on "The Failure of Steel Castings and Forgings through Fatigue," in the course of which he pointed out that the term "fatigue" was not clearly understood.

The subject of fatigue (continued the author) is likely to be in evidence now more than ever before, due to the higher stresses common in modern construction.

Mechanism of Fatigue.

When metal structures are put into service it occasionally happens, owing to an unforeseen cause, that stresses are applied that exceed the material's power of resistance. These stresses may be only a small fraction of the tensile strength of the material; in some cases they may approach the equivalent of, say, half its tensile strength, or there may be one application of a very heavy stress due to accident. In any of these instances, presuming, of course, that the power of resistance has been exceeded, some crystal of the metal which happens to be lying in the most highly-stressed region, cleaves, or possibly a number of them are broken more or less in line. Once this occurs, the danger is present. If caused by nothing but the normal stress, the process of fatigue will develop quickly.

If caused by one accidental overload, and the designed stresses are less than the metal's power of resistance, then final breakdown may not occur for months or even years. In either case, the conditions predisposing to failure by fatigue have been initiated by the breaking of the first crystal, and it is only a matter of time before failure occurs. Taking the extreme case where only one crystal is ruptured, a leading crack is formed, at the bottom of which supernormal stresses are now exerting themselves and succeeding crystals, lying in the direction of the stresses, are broken or parted. So the process goes on, the concentration of stress at the bottom of the ever-increasing crack becoming greater until finally the amount of sound metal left is just not quite equal to standing up to the load imposed upon it, and sudden complete fracture occurs.

Continuing, the author described the appearance of a fatigue fracture, and outlined the conditions likely to induce fatigue, notably bad alignment of rotating or reciprocating parts in their bearings; presence of non-metallic inclusions at the skin of highly-stressed parts; excessive and varying heat gradients; and advanced corrosion.

The author next dealt with the elastic-limit function of fatigue failures, and in this connection referred specially to the influence of non-metallic inclusions, the presence of a varying portion of which is almost unavoidable in any steel. Once fatigue has started, there is no remedy. Fatigue implies actual partition of the metal and no amount of heat treatment can close up or eradicate a crack even though its extent is only the first crystal. Another fact which should be mentioned is that when a structure has failed owing to fatigue, there is no test known which will demonstrate the presence of fatigue in the material adjacent to the crack.

The author then dealt with the mechanical aspect of fatigue failures, and indicated how failure from this cause may be avoided, pointing out that after selecting a suitable material for the job in hand, the main point was to avoid overstress either locally or otherwise.

The author concluded by indicating specific instances of fatigue failures arising from various causes.

IT IS UNDERSTOOD that the Government has decided to increase its grant to the British Engineering Standards Association from £105 to a maximum of £5,000 per annum.

Reclaiming Steel-Foundry Sands.*

By A. H. Dierker,† Columbus, Ohio.

Next to the metal itself, moulding sand is the most important raw material used in the manufacture of steel castings. There are no accurate figures available, but probably it would be safe to say that the average steel foundry uses approximately 1,000 lbs. of new moulding sand per ton of castings produced. With untreated sands costing from two to four dollars (in some extreme cases it may run as high as eight or ten dollars) per ton delivered at the foundry siding, moulding sand is an important item in the cost of making castings, and any information that may help to reduce this sand consumption should be of interest to the industry.

Fundamental Considerations.

In a general way, moulding sand in the average steel foundry passes through the cycle shown in Fig. 1. This diagram indicates that if all of the sand could be returned from the shakeout floor to the mixer no new sand would be required from the stock pile, and moulding costs would be reduced accordingly. Unfortunately, for reasons to be discussed later, it has heretofore been necessary to dilute the used sand constantly with new raw sand in order to maintain the properties that are essential to the production of satisfactory moulds.

To prevent an accumulation of sand in the foundry it has been necessary to waste used sand

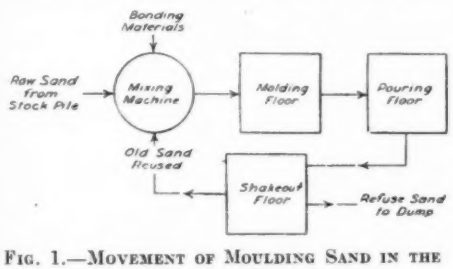

FIG. 1.—MOVEMENT OF MOULDING SAND IN THE AVERAGE STEEL FOUNDRY.

in amount equal to the new sand added. To most foundries, wasting this sand is an added expense. If it were possible to treat the used sand so as to maintain the desired properties, the only new sand required would be that necessary to replace the sand lost in the treating process and in the cleaning room, which raises the question: Can this be done; and, if so, how? This Paper covers a series of investigations made to determine:—(1) What causes moulding sand to lose its desirable properties, and (2) how these properties can be maintained or restored without the use of new sand.

Composition of Sands for Moulding Steel.

Moulding sands (in this Paper this term will be used to include core sands as well) are an aggregate of silica sand bonded with some plastic material (green binder) and, in the case of sand for dry-sand moulds and cores, an additional dry binder. The sand grains are quartz of a fairly uniform size, and in most steel-foundry sands most of the grains are between 40 and 70 mesh.

Numerous materials are used in bonding these sands, but in general they can be divided into two classes:—

(1) *Green Binders.*—These are usually a plastic colloidal material, and give the sand plastic properties when mixed with the proper amount of water. Those most widely used are fireclays, including bentonite, and "corn" flour. Corn flour is a partially dextrinised starch made from corn, and (2) *Dry Binders.*—These give the sand its maximum strength after it has been dried or baked. The more common dry binders are linseed oil, pitch, rosin, water-soluble binders such as dextrine, molasses, etc., and numerous trade-marked oils and compounds.

Most steel-foundry sands used in America are of the synthetic type; *i.e.*, a quartz sand containing little or no bonding material is mixed in a suitable machine (usually a mill of the muller type, a modified dry pan) with the proper amount of binders to form a plastic mixture suitable for moulding or core work.

Deterioration of Moulding Sands in Use.

What happens to sand that comes in contact with molten steel was strikingly shown by the following simple experiment. A hole was cut through the top of a large mould previous to pouring. The mould was then poured and, as the steel rose in the mould, a few small grains of sand were dropped on its surface. There was an immediate reaction of the sand with the film on the surface of the metal, forming a slag which remained liquid after the metal had solidified. Since the freezing point of steel is

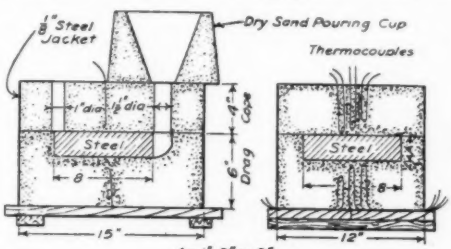

FIG. 2.—ARRANGEMENT OF THERMOCOUPLES IN THE MOULD FOR TAKING THE TEMPERATURE OF THE SAND.

below the melting point of silica or the silica-alumina eutectic, it can be seen that another flux has been introduced to react with the sand to form a low melting slag. As will be shown, the surface of the steel appears to be oxidised to a ferrous condition, which readily reacts with the silica sand.

A number of small castings, simple blocks of steel 2 by 8 by 8 in., weighing about 37 lb. each, were poured in moulds made of various sand mixtures, using dried Ottawa sand as a base. A sample of the scale formed at the contact of the steel with the sand was obtained and scraped as clean as possible from adhering sand. An analysis of this scale gave the results shown in Table I, which show that pouring steel into sand moulds introduces ferrous silicates into the sand and that these, although small in amount for one pour, would accumulate rapidly were the sand continuously re-used.

Effect of Temperature on Sand.

Immediately behind the mould face the sand is subjected to comparatively high temperatures, which vary with the distance from the mould face and the size of the casting. For the purposes of this investigation it was necessary to know, approximately at least, the value of these temperatures. For this reason, a brief investigation was made to determine the maximum temperature reached by sand in various parts of a mould in which steel had been poured.

Iron-constantan thermocouples of No. 16 gauge wire were rammed in a mould, as shown in Fig. 2. An attempt was made to keep the couple nearest the hot metal far enough from the mould face so that it would not be subjected to a temperature above 1,500 deg. Fah. (815 deg. C.). The couples were moved during the ramming operation, and it was found that the

TABLE I.—*Chemical Composition of Scale Formed at the Mould Face.**

Sand mixture. Per cent.	Analysis of Scale. FeO. Per cent.	Fe_2O_3. Per cent.	MnO. Per cent.	Fe. Per cent.
1. Sand, 94.5 .. Clay,† 5.5 ..	12.86	4.58	0.64	13.20
2. Sand, 93.2 .. Clay, 5.5 .. Pitch, 1.3 ..	17.69	0.36	0.36	14.00
3. Sand, 89.0 .. Clay, 5.5 .. Pitch, 1.3 .. Silica wash,‖ 4.2.. ..	15.41	0.60	0.45	12.40
4. Sand, 98.8 .. Corn flour, 1.2	17.23	0.40	0.50	13.68
5. Sand, 94.5 .. Corn flour, 1.3.. .. Silica wash,‖ 4.2.. ..	14.14	2.87	2.01	13.00

* It is very difficult to get comparative samples of scale, and the results, as a consequence, are not exactly comparable. They do, however, prove the point in question; namely, that the surface of the metal is oxidised, chiefly in the ferrous state; that the ferrous oxide is absorbed by the sand. The scale, when crushed to a fine powder, had the characteristic green colour of a ferrous silicate.

† Analysis of the clay used was as follows: SiO_2, 59.80 per cent.; Al_2O_3, 24.91; Fe_2O_3, 0.47; FeO, 0.72; CaO, 0.56; MgO, 0.51; Na_2O, 1.43; K_2O, 1.20; TiO_2, 1.40; Ignition loss, 9.20.

‖ 200-mesh pulverised quartz.

only reliable means of determining their location was to place them in approximately the position desired and wait until the mould had

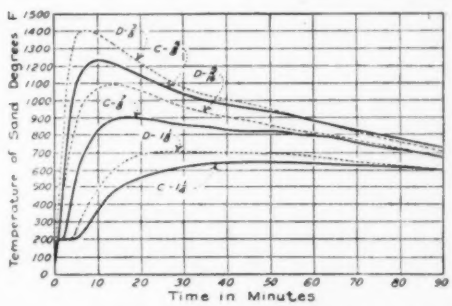

FIG. 3.—TEMPERATURE OF THE SAND AT VARIOUS TIMES AFTER POURING.

C and D indicate cope or drag. Figures following these letters indicate the distance in inches from the metal. Size of casting, 1 by 8 by 8 in. Approximate pouring temperature, 2,750 deg. Fah. (1,510 deg. C.), Sand mixture: Ottawa sand, 88; fireclay, 12; and moisture, 3.5 per cent.

been poured and readings taken; then, by carefully picking the mould to pieces, the couples could be located and their distance from the metal could be measured.

Sample No.	Size of casting. Ins.	Sand Mixture. Per cent. Sand.	Fireclay.	Moisture.
1	1×8×8	94	6	2.66
2	2×8×8	94	6	2.80
3	3×8×8	94	6	Dried.

Approximate pouring temperature, 2,750 deg. Fah. (1,510 deg. C.)

Readings were taken on an indicating potentiometer connected to the various couples through a multiple switch. It required only about 30 sec. to get the readings of the six or seven couples.

Fig. 3 gives a typical time-temperature curve for one of the tests. Fig. 4 gives the maximum

* A Paper to be presented to the American Institute of Mining and Metallurgical Engineers, Inc.

† Research Engineer, Engineering Experiment Station, Ohio State University.

temperature curves for the three sizes of castings tested.

Distance from mould face, kind and size of flask used, temperature of metal, kind of sand and moisture content, and shape of casting, are all factors which influence the maximum temperature reached in various parts of the mould. A complete investigation of mould temperatures would of necessity take these variables into consideration. The data secured, although incomplete, are sufficient for the purpose of this paper. A study of Fig. 4 reveals that the temperature reached by the bulk of the sand is surprisingly low. This is fortunate, as it simplifies the problem somewhat.

In studying the effect of temperature on moulding sand it is well to keep in mind that such sand is composed of two distinct constituents; *i.e.*, the quartz grains and the binding material used to hold these grains together

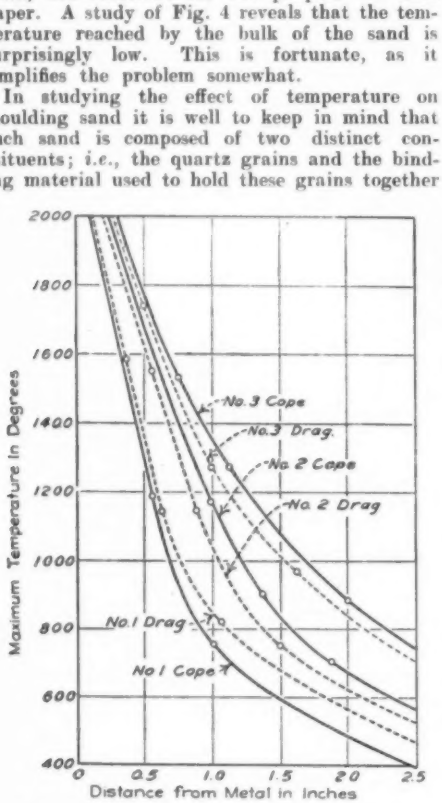

Fig. 4.—Maximum Temperature reached by the Sand in Moulds for Castings of various Thicknesses.

and give the sand its plastic properties. We will consider the binders first.

Effect of Temperature on Binders.

Fireclay.—Value of clay as a green binder lies in its colloidal properties. At higher temperatures the water of hydration is driven off and the colloidal properties are permanently destroyed. The clay used in this investigation loses its combined water markedly at 930 deg. Fah. (495) and is completely dehydrated at 1,400 deg. Fah. (760 deg. C.). The clay at the mould face may be hard burned. However, most of the clay that is affected by the temperature at all is simply dehydrated, and occurs in used sand either free or entrapped by the other binders in a coating on the sand grains.

Organic Binders.—These are the oils, starches (farinaceous or paste binders), and water-soluble materials (molasses, dextrine and sulfite pitch). They are burned out completely near the mould face but further away are merely charred and still further away are unaffected and remain as coatings on the sand grains.

Pitch.—When pitch is heated, the volatile matter is driven off, leaving a cokelike carbonaceous material. This coke is burned off only at a high temperature. In actual practice, the pitch is completely burned only from that sand which is within about ½ in. of the mould face. Most of the pitch remains as a firm coating on the sand grains. Thus, in used moulding sand, the quartz grains are surrounded by the different binders in various stages of oxidation and decomposition and a small amount of ferrous silicates from the mould face.

Significance of Changes in Sand Mixture.

A representative sample of used sand was secured and a wet screen analysis made of it (see Fig. 5). Wet screening was necessary because in dry screening the peculiar carbonaceous fine material sticks to the screen meshes.

A microscopic examination of this sand showed practically all of the grains completely coated with binding materials, especially the cokelike pitch residue. This sand was then put in a No. 0 Simpson foundry mixer (a modified form of the dry pan) and milled for 15 min. A screen analysis of the sand was made (see Fig. 5) and the particles retained on the different meshes were examined microscopically. That retained on the 12-mesh and 20-mesh screens proved to be large irregular opaque grains, apparently partly fused lumps of clay. From 20 to 100 mesh, which included the bulk of the material, the sand consisted almost entirely of clean silica grains. From 140 mesh on, increasing amounts of opaque grains were present, which were either some dark-coloured mineral or melted pitch, or both.

The dry density of the sand before milling was 1,316 g. per c.c.; after milling it was 1,667 g. per c.c.; a 27 per cent. increase. This indicates that in milling used sand the coating is

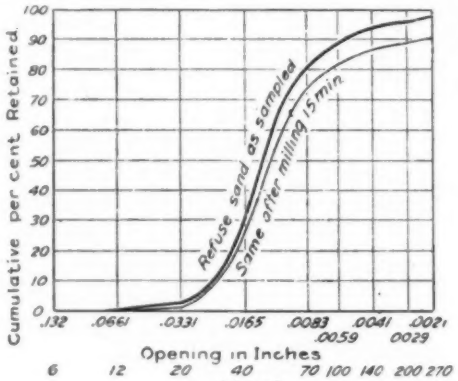

Fig. 5.—Wet-screen Analysis of Refuse Sand before and after Milling.

broken from the sand grains and ground to a fine powder which fills in the interstices between the sand grains.

If this unmilled refuse sand is to be used as it is, or with merely the free dust removed, it must first be rebonded. If the sand is rebonded in such a way that the coatings on the sand grains remain intact, the binder adheres to the coating and not to the sand grain itself; thus, in subsequent ramming operations, much of the sand-grain coating will be broken, especially adjacent to the pattern, releasing unbonded grains which may cause considerable trouble. On the other hand, if the sand is mixed intensively, as is usually the case where a pan mill is used, a large volume of free powdery material is formed, which not only fills up the interstices, decreasing the permeability, but also, because of its large surface area, absorbs a great amount of binder, making the use of an excessive amount of that material necessary.

Effective Reclaiming.

The foregoing facts show that merely removing the loose fine material from used sand is not sufficient, and that effective reclaiming involves two essential steps: (1) breaking the coating of foreign material from the sand grains, and (2) separating this foreign material from the good sand.

If the sand were treated in this way, there would remain, as good sand, comparatively clean quartz grains, which could be charged into the mixing machine as a substitute for new sand in the making of moulding-sand mixtures. The cycle followed by the sand in the foundry would then be as shown in Fig. 6. It will be noted that, in this cycle, only the sand formerly discarded as refuse is treated in the reclaiming apparatus. Treating all of the sand before re-use would involve, in most cases, the handling of excessive tonnages and would mean unnecessary expense.

This theory of reclaiming is based on the assumption that there is no appreciable deterioration of the quartz grains themselves. However, there seemed to be some question of the validity of this assumption. Muntz and Roubien[1] doubt the advisability of using old sand in facings for steel castings. They state that "under repeated heatings to high temperatures, the quartz in the sand undergoes two changes:—(1) A number of particles are broken up, resulting in easily fused sharp edges and also in smaller grains; and (2) such particles as are not broken up increase very rapidly in volume to the extent of 20 per cent. after a short time." To clear up this point, an investigation was made of the durability of moulding-sand grains under repeated heatings.

Stability Relations of Silica.

Silica (SiO_2) can form three different crystalline minerals—quartz, tridymite and cristobalite. Quartz is the form in which silica is usually found in nature; the others are of rarer occurrence.

At temperatures up to 575 deg. C. (1,067 deg. Fah.) an inversion takes place, the quartz chang-

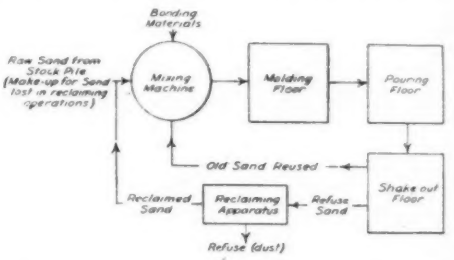

Fig. 6.—Movement of Sand in a Foundry after Installation of Reclaiming Apparatus.

ing from the alpha to the beta phase. This inversion takes place rapidly, being practically instantaneous. At 870 deg. C. (1,598 deg. Fah.) beta quartz is no longer stable, tridymite being the stable form of SiO_2. However, this inversion, in the absence of a flux, apparently does not take place and even in the presence of a flux takes place very slowly. At 1,250 deg. C. (2,282 deg Fah.) cristobalite is the stable phase and the beta quartz inverts to cristobalite. At this temperature the inversion is extremely sluggish, Fenner[2] finding that 108 hr. heating produced only a small quantity of cristobalite. At higher temperatures the velocity of inversion increases, and, according to Fenner, is fairly complete in one hour at 1,570 deg. C. (2,858 deg. Fah.).

These different inversions are accompanied by volume changes. Fig. 7 shows the linear expansion of quartz according to Le Chatelier, while the volume increase as determined by the Geophysical Laboratory is shown in Fig. 8.[3] The alpha to beta inversion of the quartz is reversible; the alpha phase exists only below 575 deg. C. (1,067 deg. Fah.), while the beta phase exists only above that temperature. The inversion to cristobalite is apparently permanent and the silica does not revert to quartz on cooling.

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1 G. Muntz and E. Roubein: "Study of the Steel Foundry Sand Problem." "Foundry" (1917), **4**, 315.

2 C. N. Fenner: "Stability Relations of Silica Minerals." "Amer. Jnl. Sci." [4], (1913), **36**, 383.

3 Figs. 7 and 8 are taken from J. Spotts McDowell: "A Study of the Silica Refractories." "Trans." A.I.M.E. (1917), **57**, 46.

Practical Considerations.

The temperature reached by sand grains in a mould depends on their distance from the metal and on the temperature and thickness of the metal itself. From the results of experiments on mould temperatures, the author feels certain that, in castings of which the sections do not exceed 1 in., only the grains within less than $\frac{1}{8}$ in. of the metal reach a temperature above 1,400 deg. C. (2,552 deg. Fah.). In the average mould this would represent less than 1 per cent. of the sand. Since the beta quartz to cristobalite inversion will not take place with any appreciable speed below this temperature, we can dismiss this inversion as a factor of any importance in the disintegration of moulding-sand grains. Between 575 deg. C. (1,067 deg. Fah.) and 1,250 deg. C. (2,282 deg. Fah.) there is practically no volume change in the quartz, and it is only the temperature up to and through 575 deg. C. (1,067 Fah.) that we need consider.

Day, Sosman, and Hostetter[4] found that quartz has a strong tendency to crack at the inversion temperature, *i.e.*, 575 deg. C. (1,067 deg. Fah.). Wright and Larsen[5] say: "The fact that thin plates of quartz may warp and bend temporarily at the inversion temperature, thus finding relief from the strains set up on the change, while thicker plates bend less easily and tend to fracture more readily, is a factor which should be considered in any particular case. Small grains being thus less liable to fracture may not show the phenomena of shattering as clearly as might be expected." It can be seen, therefore, that the size of the grain must be taken into consideration, and the author's investigation has attempted to determine whether sand grains of the size usually found in steel-moulding sands will be affected by repeated heating through the inversion point.

Types of Sand Grains.

Practically all steel-moulding sands are obtained from sandstone deposits, and the size and shape of the grains depend on the nature of their deposition. The grains of water-laid sands are irregular and more or less angular in shape; those of the æolian or wind-blown sands, due to abrasion during transportation, are rounded, and the larger grains approach a sphere in shape. In the quartzites the grains, due to metamorphism, have been consolidated into a more or less solid mass of quartz.

In mining moulding-sands from sandstones a weakly-cemented sand is usually selected, which breaks down readily and in which the original shape of the grains is retained. If quartzite is used, it must be crushed and screened, and the resulting grains are angular with very sharp edges.

In the author's investigation a sample from each of the following sands was used:—(1) Sand from the St. Peter's sandstone of Ottawa, Ill., which is a wind-blown sand; (2) a sample from the Pottsville formation near Jackson, Ohio, which is a water-laid sand; (3) crushed and screened quartzite used ordinarily as a glass sand. The Ottawa and Jackson sands were washed free from clay substance, by the standard A. F. A. method, before testing. The crushed quartzite was used as received.

In Table II the samples marked "Heated" were treated in the following manner: A nickel tray was kept in an electric resistance furnace which was maintained at a temperature of 1,200 to 1,250 deg. Fah. The sand samples were poured on to this tray and kept in the furnace for 5 min. They were then removed and poured on to a steel pan $\frac{1}{16}$ in. thick, which was kept floating on cold water. After cooling, the sand was poured back on to the nickel tray, which had been kept in the furnace, and the process was repeated. In this manner the sand was heated and cooled rapidly through the alpha-beta inversion point (1,067 deg. Fah.). Each sample was run through this heating and cooling cycle eight times. The samples marked "Quenched" were heated, in nickel crucible, to 1,500 deg. Fah. and then poured in cold water. All screen analyses were made by running 15 min. in the Ro-Tap machine.

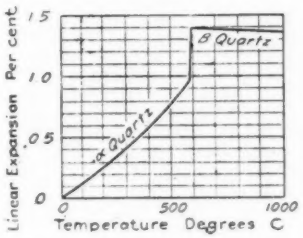

FIG. 7.—LINEAR EXPANSION OF QUARTZ (McDOWELL).

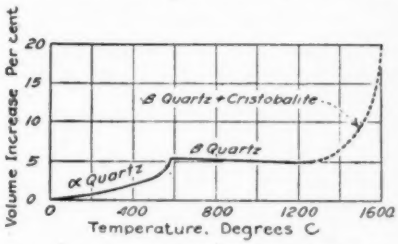

FIG. 8.—VOLUME INCREASE OF QUARTZ (McDOWELL).

After the eight heatings the sand samples were milled in a small ball mill 3 in. dia. by 3 in. long, made of case-hardened steel. The mill was loaded with twenty-five $\frac{3}{4}$-in. balls and was rotated at 40 r.p.m. for the times indicated. In screening on the Ro-Tap machine, much of the fine material (– 270 mesh) sifts out through the joints between the screens and is lost; for this reason, the amount of – 270 material was, in each case, obtained by difference.

TABLE II.—*Screen Analysis of Quartz Sands Tested for Durability.*

Sand.	Mesh.	Cumulative per cent. retained.								
		Not milled.			Milled 15 minutes.			Milled 45 minutes.		
		Washed.	Heated.	Quenched.	Washed.	Heated.	Quenched.	Washed.	Heated.	Quenched.
Ottawa, Ill.	20	0.00	0.10	0.00	0.00	0.06	0.00	0.00	0.00	0.00
	28	4.45	5.38	4.15	3.64	3.46	1.39*	2.88	1.32	0.31
	40	30.90	34.15	30.25	26.85	25.13	12.43*	19.59	11.20	3.42
	48	74.15	77.18	71.52	64.16	61.18	41.57*	49.57	38.38	18.24
	70	88.60	92.58	87.28	81.49	80.13	63.16*	66.39	59.90	35.72
	100	94.41	97.95	94.31	90.40	89.33	77.23*	78.08	74.30	56.01
	140	97.61	99.24	97.72	94.93	93.29	87.22*	85.20	82.65	71.05
	200	98.44	99.40	98.58	95.83	94.40	90.91*	87.86	85.84	77.88
	270	99.05	99.52	99.35	97.27	95.41	94.16*	90.98	89.11	85.01
	270	100.00	100.00	100.00	100.00	100.00	100.00*	100.00	100.00	100.00
Jackson, Ohio	20	0.08	0.10		0.04	0.05		0.08	0.00	
	28	2.20	2.61		0.94	1.21		0.39	0.37	
	40	14.74	16.54		9.12	10.54		3.17	3.38	
	48	73.60	77.07		52.08	59.05		27.12	29.45	
	70	90.92	91.97		74.98	79.60		51.82	54.83	
	100	95.34	96.58		84.56	88.90		65.73	70.06	
	140	98.23	98.92		91.39	93.84		77.62	80.44	
	200	98.97	99.26		93.76	95.41		82.31	84.68	
	270	99.45	99.41		95.02	96.83		87.20	88.92	
	270	100.00	100.00		100.00	100.00		100.00	100.00	
Crushed quartzite	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	28	0.11	0.12	0.07	0.00	0.00	0.00	0.00	0.00	0.00
	40	0.87	1.05	0.71	0.30	0.21	0.15	0.13	0.07	0.00
	48	34.80	32.00	34.46	25.42	23.36	18.20	16.08	11.04	4.72
	70	83.67	81.94	79.96	71.17	68.86	61.59	53.49	43.77	29.63
	100	97.06	96.29	95.91	87.88	87.16	82.14	73.27	68.50	53.95
	140	99.15	99.17	99.08	93.59	93.29	90.11	83.36	80.74	71.32
	200	99.63	99.72	99.58	95.15	95.06	93.08	86.82	85.25	78.31
	270	99.92	99.95	99.88	96.57	96.17	95.16	90.33	88.68	84.79
	270	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Milled 25 minutes.

Microscopic Examination.

The larger grains of Ottawa sand are rounded and almost spherical in shape; the smaller grains are more irregular but the edges are more or less rounded; some of the grains show small cracks; all of them are transparent. After being heated and cooled through the inversion point eight times the grains show little change. A few more appear to be cracked, but not enough more to be certain on this point. The grains of the sand that had been heated and quenched showed distinct signs of disintegration; a few of the grains had been shattered and many were badly cracked. However, about one-half of the grains showed no signs of injury. After milling 45 min., the larger grains remaining were those that were practically free from cracks. The grains of the Jackson sand are irregular with different degrees of angularity. Many of the grains are partly or wholly opalescent. Repeated heating through the inversion point seemed to increase this opalescence. However, milling tests indicate that this quality does not necessarily mean a weakness in the grains.

The quartzite consists of uniformly sized grains, angular and with sharp edges. The majority of grains are clear, but a few are opalescent. As in Jackson sand, this opalescence is increased on repeated heating through the inversion point, but this heating does not seem to affect the grains in any other way. Quenching did not seem to crack this sand as badly as the Ottawa sand, which was probably due to its normally smaller grain size, but quenching did increase the opalescence or translucency of the grains. About 75 per cent. of the grains of the quenched sand exhibited this phenomenon.

If heating through the inversion point sets up internal stresses in the grains which are not relieved by cracking, such grains should show undulatory extinction when examined with a polarising microscope using crossed nicols. The samples were examined for this property, and, although some grains in the raw sand showed undulatory extinction, the number was apparently not increased by the repeated heating through the inversion point. It must be

[4] A. L. Day, R. B. Sosman and J. C. Hostetter: "Determination of Mineral and Rock Densities at High Temperatures." "Amer. Jnl. Sci." [4], (1914), **37**, 1.

[5] F. E. Wright and E. S. Larsen: "Quartz as a Geologic Thermometer." "Amer. Jnl. Sci." [4], (1909), **27**, 438.

borne in mind that the majority of sand grains were formed originally by crystallisation from molten magmas, and that in cooling these grains pass through the several inversion points. Grains formed in this manner exhibit the characteristic properties of quartz that has been heated and cooled through the inversion points.

From the results of this phase of the investigation, the conclusion would be justified that the resistance to disintegration of quartz grains of a size usually found in steel-moulding sands is not lessened by a fairly rapid heating and cooling through the alpha-beta inversion point, *i.e.*, 575 deg. C.

The samples were cooled at a much more rapid rate than would ordinarily be the case in actual foundry practice. However, even in the case of the quenched samples, which is a much more severe treatment than the sands would ever receive in regular use, the grains are not disintegrated to a point where the reclaiming of the good portion would be unprofitable.

The results of the milling tests check fairly closely with what one would expect after a microscopic examination, and the milling test should give a good indication of how the sand grains will stand up under the milling and ramming received in the foundry. The rounded grains of Ottawa sand are most resistant to the action of the mill. The sharp edges are readily broken from the angular sands by the action of the balls and the larger grains rounded. After being rounded, these grains should be, and apparently are, as resistant to disintegration as the naturally rounded grains.

From observations in the foundry, it appears that only the grains that come in contact with the metal are broken up to any noticeable extent. Since these grains absorb ferrous iron, their disintegration is desirable, for the resulting small particles would then be removed in the cleaning operation and the ferrous iron content of the sand kept at a low point.

Table III gives the mechanical and Table IV the chemical analysis of the good sand recovered. It will be noted that the undesirable elements are concentrated in the finer materials, which are largely removed by the classifier, leaving only the small percentages shown in the good sand.

Operation of this plant for several years has proved that refuse sand can be reclaimed at a fraction of the cost of new sand. Furthermore, castings poured into moulds made of reclaimed sand mixtures are equal in every respect to those poured into moulds made of sand mixtures containing all or part new sand. In fact, sand reclaimed in this manner is much more uniform in quality than any ordinary grade of new moulding sand. This uniformity, together with the fact that it is free from moisture, makes it an ideal sand for use in the production shop where close control of the sand quality is imperative.

Table III.—*Mechanical Analysis of Reclaimed Sand.*

Sieve number.	Per cent. retained.	Cumulative.
8	None	None
12	0.27	0.27
14	0.91	1.18
20	1.60	2.78
28	10.65	13.43
40	51.82	65.25
48	26.61	91.86
70	6.66	98.52
100	0.79	99.31
140	0.24	99.55
200	0.06	99.61
200	0.10	99.71

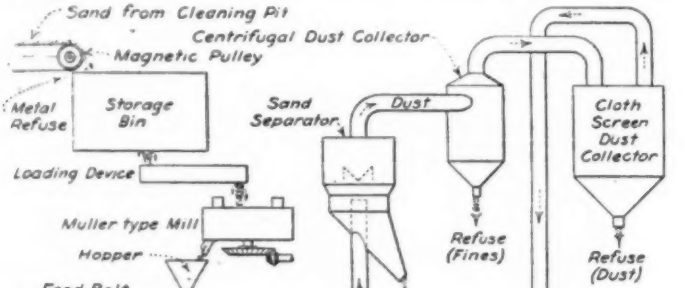

Fig. 9.—Schematic diagram of sand-reclaiming plant.

Table IV.—*Chemical Analysis of Fractions of Reclaimed Sand Retained on Screens.*

—	48 Mesh. Per cent.	70 Mesh. Per cent.	100 Mesh. Per cent.	140 Mesh. Per cent.	200 Mesh. Per cent.	−200 Mesh. Per cent.
Water ..	0.40	0.38	0.60	0.74	1.04	1.81
Carbon ..	0.66	0.90	1.50	1.74	2.70	4.00
SiO_2 ..	97.46	95.38	91.60	90.74	86.46	80.14
Al_2O_3 ..	1.18	2.47	3.43	4.12	6.85	10.29
Fe_2O_3 ..	0.10	0.06	0.69	0.61	0.74	0.71
FeO ..	0.36	0.52	1.48	2.05	2.33	3.12
CaO ..	Trace	Trace	Trace	Trace	Trace	Trace
MgO ..	Trace	Trace	Trace	Trace	Trace	Trace
K_2O ..			Not determined.			
Na_2O ..			Not determined.			
Total ..	99.96	99.71	99.30	100.00	100.12	100.07

Apparatus for Reclaiming.

After trying out, on a small scale, several types of reclaiming apparatus, it was found that the combination of a muller-type sand mill and an air classifier followed by a dust collector gave the best results.

Results from an experimental unit indicated that a recovery of more than 70 per cent. could be attained and that the reclaiming of refuse sand should prove highly profitable. On the basis of these tests a full-size unit was designed and installed. The schematic diagram shown on Fig. 9 should give a clear idea of the type of apparatus used and method of operation. There are, of course, details that contribute to the successful operation of the plant, but which have not been shown because they would complicate the diagram and are not necessary for an understanding of the principles involved. A typical week's operation of this plant showed the following:—(1) Refuse sand treated, 1,177,700 lbs. (100 per cent.); and (2) good sand recovered, 1,005,800 lbs. (85.4 per cent.).

Conclusion.

The author realises that many of the points brought out in this Paper could well have been amplified, but it was thought best to avoid lengthy discussions and give only those data pertinent to the questions involved. The foregoing investigations were conducted at the plant of the Buckeye Steel Castings Company, and the writer wishes to acknowledge his indebtedness to that company for its kind permission to publish the results.

Book Review.

Ryland's Directory, 20th Edition. Published by the The Iron & Coal Trades Review, 49, Wellington Street, London, W.C.2. Price £2 2s.

The field covered by this extraordinarily useful book is that of the coal, iron, steel, foundry, engineering, hardware and related trades and industries. The vast experience behind the production of this work which, by the way, contains more than 2,000 pages, enables the editors to provide a dual service to each section of the industries represented as buyers and sellers. Thus, if a firm of blast-furnace owners wishes to examine the potential sources of coke supply, or possible users of his products, he has in the same book complete reliable up-to-date lists. This example can be oriented to embrace the whole of the mining, engineering and metallurgical industries.

The system followed is first to give an intelligent list of the contents of the book and then a list of the towns and places. This is an extremely useful feature, for a representative can make sure in advance that he does not omit to call on a potential customer, as, on turning to the page dealing with that town in the geographical section, all the firms are listed by street number and district.

The next section lists and illustrates the trade marks of the industry. We know of cases where reference to this would have saved much time and trouble caused through selecting marks already covered.

The alphabetical section is of great magnitude, and has never been of such interest as the present time, because of the number of mergers that have taken place. These have been dealt with in a very commendable manner, and in the case of the more important mergers, histories of the participants are given. Under each entry there is given an indication of the business of the concern, whilst the nature of its proprietorship, and in the case of large public companies the capital, dividends and agencies are detailed. Brands and trade marks, too, are in many cases included.

The nature of the Geographical Section has already been indicated, and we need only amplify our criticism by indicating that the scheme followed is country, county, town (and where this last is large), street and number. This system has been also used in the larger classifications of the Trade Classified section, such as collieries, engineering works and foundries, but not for the specialities. In these numerous cases an alphabetical list is given, with the address indicated but not detailed, and reference is made to the general alphabetic section.

The next section has been designed to be of use to the technical side of the industry, as a detailed information is given of the products of the iron, steel and tinplate trades, such as sections turned by the rolling-mills, the type, analysis and brand of pig-iron smelted by the various furnaces and the like.

After a section which lists the exporters of iron, steel, tinplates and hardware, a very interesting section is devoted to the Dominions and foreign coal, iron, steel and foundry industries. This section is erroneously labelled "Foreign and Colonial," and we take exception to the continued use of the latter word. It is interesting to note that lists of foundries in Australia, Belgium, Czecho-Slovakia, Denmark, Finland, Holland, India, New Zealand, Norway, South Africa, Sweden and Switzerland have been included.

The intelligent use of this work provides the foundry industry with valuable commercial information definitely unobtainable in any other work of reference.

V. C. F.

Institute of British Foundrymen.

ANNUAL MEETING OF THE EAST MIDLANDS BRANCH.

The annual meeting of the East Midlands Branch of the Institute of British Foundrymen was held at the Loughborough Technical College on February 1.

MR. J. LUCAS, who presided, extended a welcome to the members, remarking he was glad to see the encouraging attendance.

MR. W. F. SMITH, in submitting the auditors' report, said that at the beginning of 1929 there was a balance in hand of £9 0s. 2d. Subscriptions had amounted to £166 8s. 6d., and this, together with other items received from various sources, made a total income of £212 13s. 3d. After all expenses had been met there was a balance in hand at the present time of £13 3s. 10d., which he thought was satisfactory. Among the items of expenditure in Branch No. 2 account was £23 3s. 6d. for the annual dinner, and £106 13s. 6d. incurred in entertaining the overseas delegates last summer.

MR. J. LUCAS (President), in moving the adoption of the financial statement, thought it was quite satisfactory. The Branch was in a very favourable position, and the members had every reason to congratulate themselves.

The statement was seconded and unanimously adopted.

Annual Report.

MR. H. BUNTING (Hon. Secretary), reviewing the work of the past year, said they had held seven meetings, paid three visits to foundry firms, in addition to which they had entertained the overseas delegates. This was, perhaps, the most important event of all, and everything connected with the arrangements had been most satisfactory. At the banquet held at Matlock they were honoured by a number of distinguished men in the foundry industry. The speeches were most useful, and he thought the event would be one they could record in the annals of the Branch with pride. With regard to the attendances at the meetings, they had been good. There had been an average of 75, and the lectures that had been given by foundrymen from different parts of the country had been most useful and created healthy discussion. At the beginning of 1929 the membership was 114, and the total number at the present time was 131. This was an encouraging increase, and he thought the Branch was making excellent progress. Of course, there were still a large number of foundrymen who did not belong to the Branch, and he expressed the hope that every member would make an effort to increase the number during the year. Quoting statistics during recent years, he illustrated how the East Midlands had grown in importance. Every year they had increased their numbers. In 1925 the membership advanced from 80 to 81, in 1926 from 81 to 86, in 1927 from 86 to 102, in 1928 from 102 to 114 and last year from 114 to 131. If they could maintain that average they would have no reason to complain. Their's was a most useful organisation, and he felt sure that, if every eligible foundryman could be in a position to appreciate its usefulness, that no one would desire to hold themselves aloof. By being members they were assisting each other and helping to solve the problems in the industry, which were many. He mentioned that it was the intention of the Derby education authorities to re-organise classes for foundry students next session, and that a sub-committee had been formed by the Branch to act in an advisory capacity. With regard to the Branch library, he said the books during the past year had not been in very great demand, but he hoped the members would make use of it as much as possible during the present year, as they had several excellent books.

MR. J. LUCAS thought the report most encouraging, and offered his congratulations to Mr. Bunting on the very efficient way in which he had performed his duties. Following the adoption of the report, Mr. Lucas said that his time had now arrived to relinquish office as President, but he could say that during his term he had spent a pleasant time and received much assistance from his executive officers. He had tried to do his best, and if they were satisfied, then he was.

New President Elected.

The name of Mr. T. Goodwin (Derby) was submitted as President for 1930, and this having been unanimously accepted, Mr. Goodwin took up his new duties, the retiring President expressing the hope that he would have a very pleasant and successful year as leader of the East Midlands foundrymen.

MR. GOODWIN, acknowledging the compliment, said he considered it an honour to have been invited to fill such an important position, and it would be his ambition to do all he could in the interests of the Branch and the members, so that by the end of 1930 they might have a still larger membership.

Mr. T. A. Spiers (Leicester) was elected as senior vice-president and Mr. C. W. Bigg (Derby) as junior vice-president, the two members returning thanks for the honour conferred upon them.

Messrs. H. J. S. Hilton and W. F. Smith were elected as auditors, and Messrs. T. A. Spiers (Leicester), C. Blades (Syston) and B. H. Vaughan as representatives to the General Council. Mr. H. Bunting was re-elected as hon. secretary, several members paying a glowing tribute to the efforts of Mr. Bunting, whom the chairman described as a model secretary, and of whom any organisation ought to feel proud.

MR. BUNTING, in returning thanks, said it was always his desire to do the best for the members. He spoke highly of Mr. J. Lucas, whom, he said, had proved himself a most popular President, and mentioned that in his predecessor they had made an excellent choice.

The following gentlemen were elected members of Council: Messrs. Street, Grant, Smith and Driver.

A vote of thanks was accorded the retiring President and other officers, following which the chairman mentioned that, in accordance with custom, they had arranged another Short Paper competition and had received several entries. Prizes would be awarded.

Each competitor read his Paper, and the voting as to which the members considered the best essay resulted in Mr. B. Gale (Syston) being awarded the first prize for a Paper on "A Practical Method of Testing Core Compounds," and the second award going to Mr. S. White (Sandiacre), whose subject was "Some Practical Hints on the Production of Castings in Manganese Bronze." Both Papers are printed below.

"A Practical Method of Testing Core Compounds."

By B. GALE.

Most users of oil sand are continually grumbling about the price of the mixed sand, and the greater proportion of the cost lies in the price of the binder used. The consequence is that the market is flooded with all types of binders, at all kinds of prices, and the salesmen have always a supply of test-reports to convince the buyer that his particular binder will make as good, or even better cores than the binder the buyer is using, at a considerably lower price.

The foundryman who has a good oil-sand mixture may accept the reports of the salesman and find himself landed with a batch of waste cores and binder, and he will then vow he will never change from his good mixture again. So, for the sake of a little practical testing in his own foundry, he may possibly go on paying a much higher price than he need.

The writer claims to be using a good oil-sand mixture, but is always prepared to test out any new binder, with a view to producing the same quality core, or better, at a lower cost, and the following is a simple method of comparing a new binder with the one in use.

The new binder is measured into the mixing-mill at the same proportion of binder to sand as is used with the present binder. It is milled for 5 minutes and placed on the bench. A mixing of the normal binder is also milled for 5 minutes and placed on the bench. Then a measureful of each type of binder is weighed and costed out at its particular price per cwt. Mixing-time being equal, a comparison of these figures will indicate which is the cheaper price per cwt. of mixed sand. Should it be found necessary to mix one type longer than the other, time of milling, use of power and machinery, must be taken into consideration. The writer then takes tests for green bond by making a 12-in. × 1-in. × 1-in. core in each type of sand and sliding them over the edge of the plate until the end breaks. The pieces remaining on the plate are measured, the shorter obviously being the one with the strongest green bond. Another test-core is then made in each type of sand and placed in the oven at the same time, and on the same shelf. Baking-times will undoubtedly vary with different binders, and particular notice of the baking-time is taken and compared to show which is the cheaper in time, fuel consumption, etc. The dried cores are then compared for smoothness of skin.

They are then tested for transverse strength by setting the cores on 10-in. centres and suspending a bucket to the centre of the core and gradually weighing until the core breaks, care being taken to weigh with small material so that the reading can be governed to at least 1 lb. The next test is for water absorption. The pieces of core are placed on end in a glass containing 1 in. of water, and left for 5 minutes. They are then examined, and a measurement of the distance that the water has softened the cores above the 1-in. water-level will decide which is the more waterproof mixture. The last test is to make two identical castings with no venting of either the core or the mould. The castings can be examined for scabbing or blowing, and also the manner in which the burnt sand leaves the castings during fettling.

The tests mentioned can be carried out with a free sample pint of binder that any supplier will be pleased to send, and may be the means of a considerable saving on core sands.

"Some Practical Hints on the Production of Castings in Manganese Bronze."

By G. WHITE.

The extreme liquid contraction of manganese bronze makes it a rather difficult matter to produce castings free from shrinkage holes wherever the section of the casting varies, unless some means are taken to prevent this. The writer has seen examples where the section varied to the extent of only ¼ in., yet the castings have been complete failures owing to shrinkage holes in the thicker section. In compiling this short Paper he has tried to give some hints gathered from practical experience in the making of castings in manganese bronze. The castings referred to varied in weight from a few ozs. to 1½ cwts. During the war period the author was engaged for some time in experimenting with castings in this metal, with a view of eliminating shrinkage holes and reducing the quantity of risers as far as possible. In passing, it should be stated that risers may absorb some-

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thing like 75 per cent. of the molten metal, and can be and were a very serious item before these experiments were made. Apart from adding to melting costs, it also increased fettling costs, as all runners and risers had to be sawn from the casting. As a result of these experiments, chills were used on all castings where thick and thin sections adjoined; in some cases, especially in the case of wheels having thick chubby rims, the chill completely encircled the casting. Chills were incorporated in the cores where it was found necessary, and this method of chilling, both inside and out, proved completely effective in curing the trouble referred to. Some idea of the difficulty of obtaining sound castings in this metal may be gathered when one particular job, which was first cast *without chilling*. There were gear blanks, 6 in. in dia. by 4 in. thick, and to obtain sound castings by this method it was found necessary to put on a riser the full diameter of job and 6 in. deep, making a total depth of 10 in. With chilling, this job was made its normal depth, and the riser was cut down to 1½ in. dia., which gives some indication of amount of metal saved. In casting the best results are obtained when the metal is introduced into the mould with as little agitation as possible, as this prevents to to great extent the liberation of zinc oxide, which causes an unsightly casting, whilst bottom pouring should be practised as far as possible. The metal should be poured at as low a temperature as possible (consistent with filling every corner of the mould), when castings of a beautiful golden colour will be the result. Casting at too high a temperature will give castings with a dirty white skin, due to zinc oxide. The procedure in moulding is much the same as for brass, with the exception that runners need not be so large, as this metal is very free running despite its apparent sluggishness. All castings were cast green sand, using Mansfield sand, well milled, and then passed through a mixer of the Herbert type. In preparing this Paper, the author does not wish to pose as an expert, but trusts that the hints contained in this Paper, which are of a purely practical nature, may help in some degree any members of the industry who may be called upon to produce castings in this somewhat difficult metal.

MR. T. GOODWIN (President), commenting on the Papers, said they were excellent, and although some of the members had failed to secure a prize, he thought they were good enough sportsmen not to be downhearted. They would not always be in the unsuccessful class, and he would, therefore, appeal that they make a further attempt in the future. The short Paper competition was most educative, not only to the members who submitted them, but to others as well. The first and second prize winners had, he thought, dealt with their subjects most carefully, and the voting had been most fair.

MR. BUNTING called attention to the annual dinner of the Branch, that was to be held at Loughborough on March 1, and appealed that every member should attend, and thereby help to make the function as successful as its predecessors. They would again have some well-known men as speakers.

THE 1930 EQUIPMENT PROGRAMME of the Canadian National Railways involves the expenditure of large sums on new rolling stock, rails and other steel products. The Canadian Car & Foundry Company, Limited, of Montreal, has already received an order for 2,250 box cars of 50 tons capacity and 25 tank cars of 10,000 galls. capacity each. This contract is reported to involve an expenditure of $6,250,000. The National Railways have also ordered 1,175 box cars from the National Steel Car Corporation, Limited, of Hamilton, at a purchase price of about $3,500,000. The Eastern Car Company, Limited, of Trenton, N.S., a subsidiary of the British Empire Steel Corporation, is to build 200 refrigerator cars and about 1,000 box cars. Large orders have also been placed for steel rails and other material. The Algoma Steel Corporation is to supply 40,000 tons and the Dominion Iron & Steel Company, Limited, a total of 80,000 tons.

Westland Foundry Extensions.

In our issue of February 14, 1929, we published an article on the Westland Foundry of Messrs. Petters, Limited, of Yeovil. Amongst other features mentioned was the installation in the heavy section of a portable sandslinger, and referred to the satisfaction this machine had given to the foundry manager, Mr. Derry.

After approximately twelve months of regular operation the demands on the foundry for castings for the Petter Atomic Diesel series of engines had so increased that this machine could not handle the required output, and it was decided to replace it with a machine of similar make of the motive type. This work has now been carried out, and Fig. 1 shows the new machine in operation. The sandslinger, which is of the Beardsley-Piper design, supplied by Foundry Plant & Machinery, Limited, of Glasgow, is arranged to run on a rail track laid in the heavy castings bay. The radial arm has a radius of 17 ft. 6 in. from the centre of the track, giving a path 35 ft. wide, which can be covered for a length as far as the track extends. The ramming unit may be operated at 4 ft. 3 in. to 7 ft. 3 in. from floor level. The machine carries a large sand hopper of 200 cub. ft. capacity. The hopper is mounted on a heavy girder framework, and sand from the hopper is conveyed to the elevator of the machine by means of a continuous belt of corrugated slats, the top run of which forms the bottom of the hopper. This endless belt is operated through the medium of a ratchet and pawl mechanism feed at the side of the machine, which imparts an intermittent motion. From this endless belt the sand is deposited in the riddling hopper, and from thence is picked up by the buckets of the vertical elevator. Scrap from the riddle is thrown out at the side of the machine through a shute. The bucket elevator deposits the sand at the top of the column on an endless belt running on rollers on the radial arm and thence to a second endless belt to the impeller head.

The complete machine travels at approximately crane speed along the foundry, traction being provided by a 15-h.p. motor. The elevator and hopper bottom endless belt are driven by means of a 7½-h.p. motor, the two conveyor belts on the radial arms by a 1-h.p. motor each, and the impeller itself by a 12½-h.p. motor. The impeller head is raised by means of an electric motor of 1 h.p. driving through a worm reduction gearing a winding drum over which runs a steel cable suitably arranged to raise or lower the outer portion of the radial arm.

When trying out the machine the sand hopper was loaded from the sand dump by bucket from the crane, but a proper loading bin has now been installed. As will be seen from Fig. 2, this bin is supported on steel stanchions, and it is loaded by means of a bucket elevator on either side. These elevators are driven by means of two 3-h.p. motors arranged above the bin or hopper, which has a capacity of 20 tons. The capacity of the machine hopper is 10 tons, or, as previously stated, 200 cub. ft. of sand. To load the machine it is run in underneath the hopper, and three sliding doors in the bottom of the bin operated by means of chains running over chain wheels. These wheels operate the sliding hopper doors through racks and pinions, and it is the work of a few moments only to fill the machine hopper.

The actual work of ramming is done at the rate of about 10 cub. ft. of sand per minute, and the quality of the castings produced is found to be of a high order.

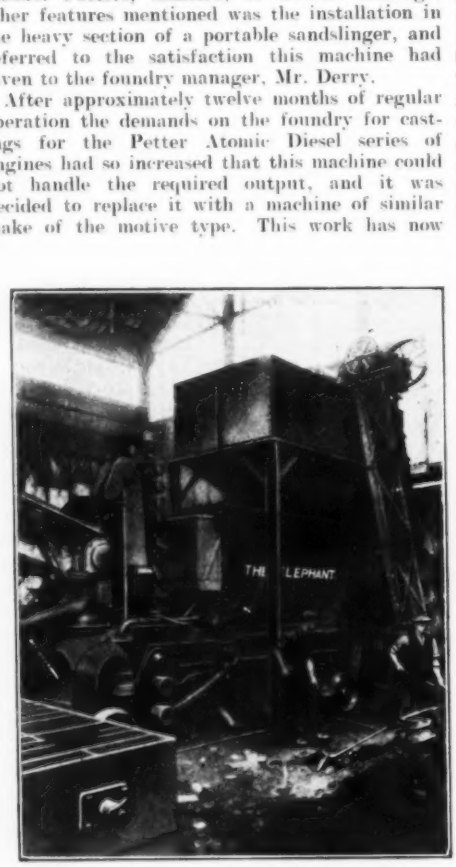


FIG. 1.—MOTIVE SAND SLINGER (WESTLAND FOUNDRY).

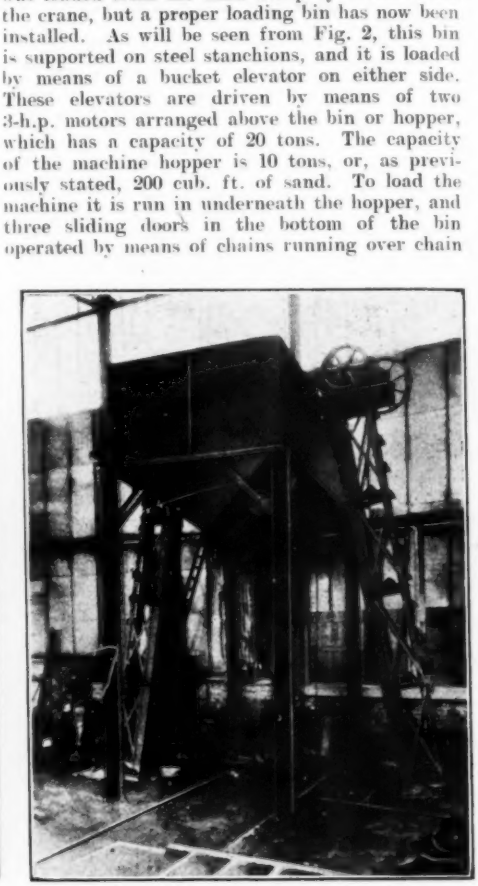


FIG 2.—SAND HOPPER FOR USE WITH THE SAND SLINGER.

An Important Electrical Contract.

The Metropolitan-Vickers Electrical Company, Limited have recently secured an order for the complete machinery and plant for the new Montevideo State Electric Super-Power Station. The order comprises two 25,000 kw., 3,000 r.p.m., turbo-generator sets, each with direct-coupled exciter and 750-kw. auxiliary alternator, central-flow condensing-plant, with motor-driven circulating and extraction pumps and full-capacity air ejectors; a 750-kw. geared turbo-alternator; the necessary water-tube boiler equipment, pipework and valves; complete switchgear, involving 26 K6A and 62-K3 electrically-operated circuit breakers; control equipment of the double-fronted desk type, all with provisions for extensions; auxiliary service switchboard; 7,400-kw., of three-phase station auxiliary transformers; accumulators and charging equipment; cable work and automatic telephone equipment.

The contract, running into nearly three-quarters of a million pounds and including no civil work or buildings, is probably one of the largest ever placed in this country for a power station overseas. The site of the new power station will be close to the sea wall and less than half a mile from the existing station.

Newcastle and Middlesbrough Foundrymen Visit Marine Engine Works.

On January 25, 1930, the Newcastle and Middlesbrough Branches of the Institute of British Foundrymen combined in a visit to the works of Messrs. Richardsons, Westgarth & Company, Limited, Hartlepool, by the kind invitation of the company. About 80 members were present at the visit, after which there was a joint meeting at the Technical College, West Hartlepool, when a Paper entitled "Is Technical Education Worth While to the Foundryman?" was presented by MR. W. H. MEADOWCROFT, of Burnley.

The company of Thomas Richardson & Sons, Hartlepool Engine Works, the predecessors of Richardsons, Westgarth & Company, Limited, was founded about 87 years ago. Originally, the manufactures were chiefly colliery and railway plant and locomotives. The firm commenced the manufacture of marine engines in the earliest days of steam propulsion, the first being built in 1854. The introduction of the compound engine in 1870 marked a real advance in marine engineering; the firm confined its activities largely to this type of work, and was the first on the North-East Coast to build triple-expansion engines, in 1883, about which time the machinery of a number of large steamers of the Union & Castle Line's South African fleet was converted from the compound to the triple-expansion type at the Hartlepool works.

The firm was always ready to investigate new ideas and methods, and for driving the works machinery the electric drive, with three-phase motors, was adopted in 1895—the first installation of its kind in the country—including electric crane equipment for the foundry.

In 1900 an amalgamation was effected with the engineering establishments of Sir Christopher Furness, Westgarth & Company, Limited, Middlesbrough, and William Allan & Company, Limited, Sunderland, under the title of "Richardsons, Westgarth & Company, Limited." The three works were re-modelled and extended, and the machine-tool equipment modernised. The progressive policy was continued and shortly afterwards the company commenced the manufacture of power-station equipment, including steam turbines, condensing plants, cooling towers and water-tube boilers. It was a pioneer in the manufacture of Diesel oil engines for marine propulsion, and in 1912, in conjunction with Carels, Frères, Ghent, built and installed in a vessel an engine of this type, which proved satisfactory. The war delayed progress in oil-engine work, but in 1921 Diesel engines of the Beardmore-Tosi type were built, which have proved highly satisfactory in operation.

At present the company is busily employed in the manufacture of marine oil engines of the Doxford type, and have now completed the development of their own marine oil engine, which has solved, on relatively simple and straightforward lines, the problem of the two-stroke double-acting oil engine. This means reduced weight and first cost for a given power output, and in the Richardsons-Westgarth design further endeavour is being made to combine these advantages with a minimum complication of mechanism, thus ensuring greater efficiency and economy of upkeep. The first engine of this type has now been installed in the M.V. "Irania," and has operated in an entirely satisfactory manner. The visitors inspected a Doxford internal-combustion engine, which was running on test-bed.

At the Hartlepool works the principal manufactures are heavy marine and land work, including steam turbines up to 60,000 kw. in single units, and condensing plants of the largest sizes. Arrangements have been made for the building of turbo-generators of any size under the patents of Messrs. Brown, Boveri & Company, Switzerland, thus enabling the company to supply complete power-station equipments. Up to the present the Sunderland works have been confined to marine engines only, but the Middlesbrough works, being in the Tees iron and steel centre have, in addition to marine work, specialised for many years in the manufacture of rolling-mill engines, blowing engines, metal mixers, gas engines, gas washers and other steel-works plant. To-day the three works are amongst the best-equipped on the North-East Coast. They cover a total area of 23 acres, and each works has a considerable frontage, with quays for fitting out vessels and the necessary sheer-legs and cranes.

The total number of workmen normally employed is about 2,300, and the company is capable of turning out yearly 50 sets of marine engines and boilers of approximately 130,000 i.h.p., together with a large output of land work as previously mentioned.

After being conducted round the works, the visitors were entertained to tea by the company. On behalf of the visitors, MR. WILSON, past-President of the Middlesbrough Branch, expressed sincere thanks to the directors and staff of Messrs. Richardsons, Westgarth & Company for providing the very excellent opportunity they had had that afternoon of visiting the works. He thought that the numbers of those present showed that the company's kindness was appreciated.

MR. PAULIN seconded Mr. Wilson's remarks. He personally had seen a great deal that afternoon which was most interesting, and many points had been explained to him by members of the staff. A matter on which they had to congratulate Messrs. Richardsons, Westgarth & Company, Limited, was the courage required to tackle such a change as had taken place in marine engineering, from steam to Diesel engines. He greatly admired some of the new machines they had installed, including expensive grinding plant. A number of changes had been necessary in the foundry for manufacturing Perlit iron.

MR. CLARK, managing director of Messrs. Richardsons, Westgarth & Company, Limited, replied on behalf of the company, and thanked them for the kind words and the hearty vote of

PATTERN SHOP, MESSRS. RICHARDSONS, WESTGARTH & COMPANY.

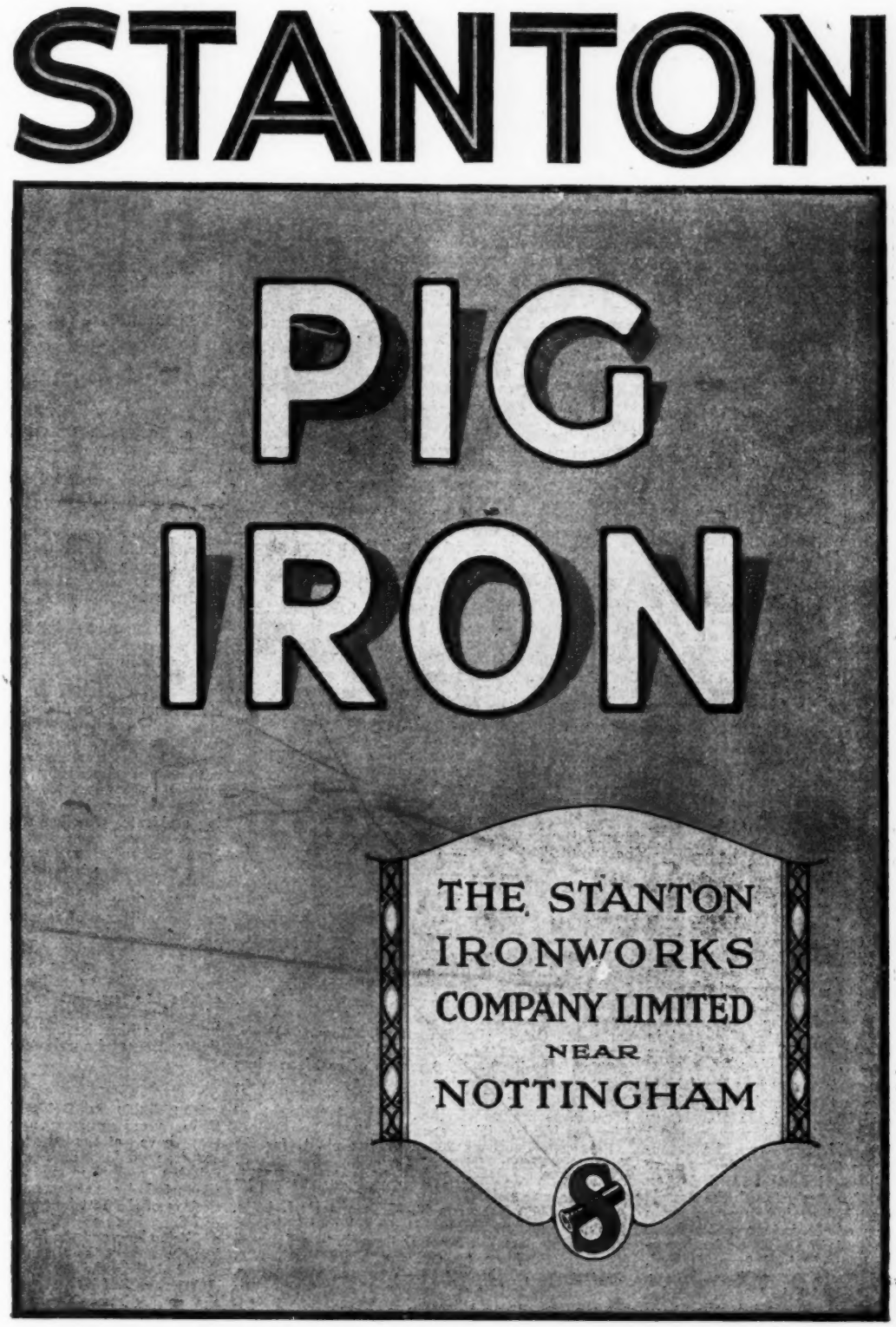
thanks which they had accorded them. He regretted that they had had so little time at their disposal. He was always pleased to see any of their Associations, no matter to what branch of the industry they might belong. At the present time, unfortunately, they were not working at full pressure. They were optimists, however, and felt sure that very shortly they would get their share of orders. To-day the Diesel engine was coming rather to the front, and he hoped that it would become still more important. He was quite certain, however, that the ordinary steam engine would never be discarded. It was necessary to use the coal of the country, but engineering progress should not be hindered because there was coal in England. That coal could be used to produce oil, and if the internal-combustion engine was the cheaper mode of propulsion, then shipowners must adopt it, as England lived on food imported from abroad. The visit was followed by an address on "Technical Education" by Mr. W. H. Meadowcroft, which is published elsewhere in this issue.

Erecting Shop, Messrs. Richardsons, Westgarth & Company.

The Foundry, Messrs. Richardsons, Westgarth & Company.

Catalogue Received.

Pulley Blocks.—The Vaughan Crane Company, Limited, Openshaw, Manchester, have sent us a well-illustrated price list covering the technical details of a comprehensive range of pulley blocks. Included in the booklet are data in connection with travelling jibs, chain slings and grabs, and Vaughan electric blocks, but in this last case interested people are referred to another publication—No. 10.


STANTON
PIG
IRON
THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

Trade Talk.

British Reverberatory Furnaces, Limited, have removed from 82, Victoria Street, S.W.1, to 88, Kingsway, London, W.C.2.

The employees of Messrs. Butters Bros. & Company, Limited, Kinning Park, Glasgow, have contributed to various institutions the sum of £94 3s.

Messrs. R. & W. Hawthorn, Leslie & Company, Limited, Hebburn-on-Tyne, have received an order for a third oil tanker for the Anglo-Saxon Petroleum Company.

The Caledon Shipbuilding & Engineering Company, Limited, Dundee, have received an order from Aktiebolaget Gotaverken, Gothenburg, for a motor tanker of approximately 11,000 tons.

Messrs. William Hamilton & Company, Limited, Port Glasgow, have launched the steel-screw steamer "Bio Bio," built to the order of Messrs. The Compania Sud-Americana de Vapores, of Valparaiso, for passenger and cargo service on the West Coast of Chile.

The steamer "Avon" has been sold by the Royal Mail Steam Packet Company to Messrs. Thos. W. Ward, Limited, Sheffield, and is to be dismantled. She was built by Messrs. Harland & Wolff, Limited, 23 years ago, and is a twin-screw ship of 11,073 tons gross.

Contracts to the value of £200,000 have been placed by the Hackney Corporation with Messrs. C. A. Parsons & Company, Limited, Newcastle, and Messrs. A. Reyrolle & Company, Limited, Hebburn-on-Tyne. The orders placed with Messrs. Parsons are for turbine plant, and with Messrs. Reyrolle for switchgear.

Messrs. Barclay, Curle & Company, Limited, Clydeholm Shipyard, Scotstoun, have received an order to build a motorship for Messrs. Burns, Philip & Company, Limited, Sydney, Australia. The vessel will be of 5,000 tons gross, and driven by Harland "B. & W."-type Diesel engines supplied by Messrs. John G. Kincaid & Company, Limited, of Greenock.

The Fairfield Shipbuilding & Engineering Company, Limited, Govan, launched, on February 4, the steamer "Princess Joan," the second of the vessels being constructed for the British Columbia Coast Service of the C.P.R. The vessel is of 365-ft. length overall, with a breadth of 52 ft. and depth 19 ft. and of 5,000 tons gross. The machinery, consisting of quadruple-expansion engines, is being supplied by the builders.

The wrought-iron department of Messrs. William Cooke & Company, Limited, Sheffield, was to have closed down. The management stated last Monday, however, that, owing to the goodwill of customers, who heard of the proposal to close, it would be possible to keep open another fortnight, and perhaps one mill would remain in operation for a longer period. The firm had received orders for wrought iron which their customers would put into stock.

The recent double fatality at Summerlee Iron Company's blast furnaces at Coatbridge was dealt with at a fatal accident inquiry at Airdrie. The evidence showed that four men were engaged on repair work at the outside wall of one of the blast furnaces, when a blow-out occurred by the gases forcing a way through the wall and enveloping the men in flames. Two of the men died as a result of the injuries they received. The jury returned a formal verdict, with a rider to the effect that in future such repairs should not be carried out unless the blast is off the furnace.

Manchester engineering interests anticipate better times, according to the annual report of the Engineering and Metal Section of the Manchester Chamber of Commerce. While last year was not a good one for textile machinery makers, the strenuous efforts to reorganise the cotton industry have given rise to the hope that there will be an awakened interest in the products of the textile machinery trade. Electrical engineering was again the most active section of the industry. Statistics showed a new high record in export trade, important contracts having been obtained from Holland, Hungary, Greece and Spain, as well as from a number of other markets which had been regarded as closed for some time. A greater volume of business was also forthcoming from South American countries.

The directors of the English Electric Company, Limited, which has an authorised share capital of £5,000,000, of which £2,647,588 has been issued, propose to reduce the capital by £1,755,000. It is intended to extend payment of the 5½ per cent. sinking fund first mortgage debentures for 20 years to January 1, 1960. Each holder will retain 35 per cent. of his stock, and will exchange 50 per cent. for 6½ per cent. preference and 15 per cent. for ordinary shares. Conversion rights will be cancelled. The preference shares will be written down from 20s. to 12s. 6d. each, of which 10s. will be represented by preference and 2s. 6d. by ordinary shares. The reduced shares will later be consolidated. The dividend on the preference shares will be raised from 6 to 6½ per cent. The ordinary shares will be written down from 20s. to 3s. 4d. each. The shares will then be consolidated into £1 shares.

The Federation of British Industries, in its quarterly trade forecast, issued at the end of last week, states that a period of readjustment lies ahead. While, at the moment, there appear to be no reasons for anticipating a general setback in British trade, it is to be feared that our trade activities overseas cannot fail to be affected for a time owing to the disorganisation which the American financial collapse has entailed in the markets for basic raw materials, whose producers are normally among our best customers. Increased selling pressure from American exporters is also likely to make itself felt, though the danger in this direction can easily be exaggerated. Looking ahead, while there are grounds for anticipating a relatively early recovery from the present low level in many directions, some considerable time is likely to elapse before the resumption of a sustained general upward movement again becomes possible. An essential pre-requisite is a substantially lower level of international money rates than at present ruling, accompanied by a revision of current estimates as to the future long-term rate of interest.

More than 10 years have now elapsed since the British hacksaw makers brought into operation a standard price-list for hacksaw blades. During this period certain anomalies and inaccuracies in the list prices have become apparent, more particularly in regard to light-power and double-edge blades. With a view to correcting these, and also arriving at some measure of simplification, the British and American Hacksaw Manufacturers' Associations have agreed upon a new price-list on the more practical basis of a price per lineal inch for each width and gauge. It is anticipated that the German Hacksaw Makers' Association, with whom the British makers have been in negotiation, will also adopt the British-American list. The new list includes 61 sizes only, which should meet all requirements. The 1919 list included 139 sizes, a large number of which were quite redundant. It is realised that in certain instances special sizes may be required. Such unlisted sizes will be quoted for and made to order, on the understanding that the quantity supplied may be within 20 per cent., more or less, of the quantity specified. It is, however, confidently anticipated that users of hacksaw blades will adopt the sizes listed as standard for their future requirements. These sizes have been unanimously adopted by the manufacturers, and, after May next, all orders will be executed at the new prices.

Contracts Open.

Birkenhead, February 18.—Iron and steel stores, for the Birkenhead Corporation Tramways. The General Manager, Laird Street, Birkenhead.

Bognor Regis, February 26.—Pumping machinery, for the Urban District Council. The Water Department Office, London Road, Bognor Regis, Sussex. (Fee £2 2s., returnable.)

Cairo, March 20.—1,800 metres of cast-iron pipes and 521 metres of double-wrapped steel pipes, etc., for the Ministry of the Interior, Municipalities and Local Commissions Section. The Department of Overseas Trade. (Reference A.X. 9,072.)

Farnham, February 26.—Pumping plant, for the Farnham Urban District Council. Messrs. J. Taylor & Sons, Caxton House, Westminster, S.W.1. (Fee £5, returnable.)

London, W., February 26.—Iron and steel, bolts, nuts and metal screws, and steam tubes and fittings, for the Hammersmith Borough Council. The Borough Electrical Engineer, 85, Fulham Palace Road, W.6.

Manchester, February 18.—Iron and steel stores, for the Corporation (Transport Committee). The General Manager, Corporation Transport Department, 55, Piccadilly, Manchester.

Rochdale, February 22.—Cast-iron main, pipes and specials, and wrought-iron tubes and fittings, for the Corporation. The Engineer and Manager, Gas Department, Dane Street, Rochdale.

Swansea, February 15.—Cast-iron pipes and specials, etc., for the Town Council. The Water Engineer and Manager, 1 and 2, Cambrian Place, Swansea.

Personal.

Mr. W. F. Prentice, formerly commercial manager of Messrs. Bolckow, Vaughan & Company, Limited, and now sales manager of Messrs. Dorman, Long & Company, Limited, has been elected a director of the Darlington Rolling Mills Company, Limited.

Mr. John Roberts has resigned his appointment as Fuel Officer at H.M. Office of Works, in order to devote the whole of his time to his consulting practice in low-temperature carbonisation, high-temperature carbonisation and shale distillation, especially the commercial testing of plants. His new office is at 5, Victoria Street, Westminster, S.W.1.

Wills.

Jobson, D. A., of Dundee, iron and metal merchant	£28,595
Smith, W. B., of the Clydesdale Steel & Foundry Company, Glasgow	£42,831
Barnett, E. S., of Sedgley, Staffs, chairman of the Cannon Iron Foundries, Limited, Deepfields	£78,354
Dickson, D., a director of the Forth & Clyde & Sunnyside Iron Companies, Limited, Falkirk	£152,693

Obituary.

Mr. Allan E. Smedley, managing director of Messrs. Smedley Brothers, Limited, Eagle Ironworks, Belper, died on February 1 in his 69th year. He had been associated with the firm for over 50 years, and had been the managing director since 1900.

We regret to announce the death of Mr. John Charles Jeffrey Smith, chairman of the Camelon Iron Company, Limited, Falkirk, which occurred suddenly from heart failure on January 31, at his residence in Edinburgh. Mr. Smith, who was in his 73rd year, was the only son of Mr. John Smith, solicitor, Falkirk, and founder of the Camelon Iron Company, which commenced business in 1845. Mr. Jeffrey Smith assumed the management of the business in 1894, but he had for some time previously been a director. He set himself to cultivate the closest and most cordial relations with the workmen, and to this end he established in 1900 a Works Committee, upon which each department was represented by the men elected by themselves, together with others elected by the directors. Such committees were appointed to look after the welfare of the employees, especially with a view of preventing accidents. Another sub-committee administered an emergency fund sustained by annual subsidy from the company for the alleviation of urgent cases of sickness and distress amongst the workers. It was very largely due to Mr. Smith's activities that the Technical Institute was formed in 1919 for the assistance of founders in the investigation of and solution of the many problems with which they are faced in modern conditions of the industry. For some time, owing to ill-health, Mr. Smith had ceased to take an active part in the management of the business, but he continued in the capacity of chairman of the company to show the keenest interest, which he maintained to the end, in all that concerned its welfare and that of the workmen.

Iron Oxide in O.-H. Steel.—During the past three years numerous writers and investigators have attempted to estimate the amount of iron oxide in open-hearth steel by calculation and by analysis. Experimental work conducted by the members of the Metallurgical Section of the Pittsburgh Station of the U.S. Bureau of Mines, in co-operation with the Carnegie Institute of Technology and the Metallurgical Advisory Board, has shown that the amount of iron oxide dissolved in liquid steel in the open-hearth furnace is very much higher than had been thought heretofore. Apparently the carbon-iron-oxide reaction is slow enough, so that the metal is essentially saturated with iron oxide with respect to the slag under a rather wide range of conditions in the open-hearth furnace. This fact changes the concept of methods of working open-hearth heats to a considerable extent in that it emphasises the importance of chemical composition and physical properties of the slag and the necessity for an even more careful study of deoxidisers than has been carried out hitherto.

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If the British Government imposed

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would it be fair to British Steel Founders if the Government permitted the import of foreign castings without imposing on them a duty of a similar amount.

?

And yet, in a lesser degree, that is the exact position to-day.

The cost of British Steel Castings, and of the ingredients used in producing them, is the cost of the labour employed, just that, neither more nor less.

That cost is the standard rate that must be paid PLUS the burdens laid on it by the British Government, as for instance, Health and Unemployment Insurance.

THERE ARE NO SUCH BURDENS ON IMPORTED CASTINGS, THE RATE OF WAGES PAID IN THEIR PRODUCTION IS FAR BELOW BRITISH STANDARD RATES AND YET THEY ENTER BRITAIN FREE OF ALL DUTY!!

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THE PRODUCTION OF "YORKSHIRE SAND" USES BRITISH STEEL AND IRON, AND FINDS CONSTANT EMPLOYMENT FOR BRITONS WHO WOULD OTHERWISE HAVE TO BE MAINTAINED IN IDLENESS BY THE NATION.

Ought not the British Steel Trade and the British Sand Trade to stand shoulder to shoulder for mutual support? Apart from that, there is nothing in the way of Sand, as good as "Yorkshire Sand" for Steel Castings.

WE SUBMIT THE PROPOSITION TO YOUR CONSIDERATION.

Make a point of visiting our Stand No. 1, Row 11b, in the Gas Industries Section of the British Industries Fair, Birmingham, 17th to the 28th of February.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Markets for Cleveland iron, so far as the month has progressed, have entirely failed in removing the depression recently prevailing, and, instead of improved conditions, the industry is now faced with a further dwindling of demand almost unprecedented at this season of the year. The position, doubtless, has been accentuated by the existing uncertainty of the industrial outlook, which since the beginning of the year has become distinctly gloomier. Even consumption of pig-iron in the local steelworks is now much reduced, and makers are finding it more and more difficult to dispose of their output in the face of keen competition from other centres. Possibly a less pessimistic view would be taken if the British foundries were busy, but fiscal uncertainties are hampering trade all round, and North Country consumers are strictly limiting their purchases to the extent of their immediate requirements. Generally it may be said that the volume of business is now insufficient to absorb the present output; stocks are increasing, and the stoppage of one or more blast furnaces in this area is by no means a remote possibility. Prices, however, remain stationary as follow:—No. 1 Cleveland foundry iron, 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s. per ton.

The weakness of the market is equally, if not more, apparent in the East Coast hematite trade. If the recent demand be accepted as the standard of normal trade requirements, there is certainly over-production, and the reduction of output cannot long be delayed. Prices are nominally unchanged, with mixed numbers at 78s. and No. 1 quality at 78s. 6d. per ton. Yet these are really full prices, and could no doubt be shaded. On the North-West Coast Bessemer mixed numbers are quoted at 79s. per ton, at works.

LANCASHIRE.—In the local markets for foundry pig, demand has undoubtedly fallen off appreciably and buyers are showing no marked disposition to commit themselves further. Current business, consequently, has largely been a matter of replacement contracts, with general buying interest much quieter than it has been of late. Prices remain unaltered, with Derbyshire and Staffordshire brands quoted at 77s. per ton, and Scottish descriptions at 95s. per ton, all delivered equal to Manchester.

THE MIDLANDS.—The anticipation of renewed activity of demand for foundry pig in the Black Country has so far failed to materialise, and business in this section is quiet and dull. No variation in current quotations has been made, prices still ruling firm at the minimum zone rates, which are 75s. for No. 3 Northants and 78s. 6d. for No. 3 North Staffordshire and No. 3 Derbyshire, delivered to local stations.

SCOTLAND.—Complaints continue to be heard of the slowness of the demand for Scotch pig-iron, but in spite of this the price remains firm at 78s. f.o.t. furnaces for No. 3 foundry. There is practically no demand for Middlesbrough iron. Continental foundry iron is much cheaper, and consumers are fairly well covered in the latter for some time to come.

Finished Iron.

Manufacturers in the Black Country district report only a moderate demand for this class of material, so far as crown bars and the nut and bolt grades are concerned. There continues, however, to be a satisfactory demand for Staffordshire marked bars, as well as for other high-grade iron. The former are quoted at £12 10s. at works, which is the official price. Crown-iron quotations vary from £10 to £10 10s. The specifications which are coming through lack volume, and the warehouses are not specifying at all freely at this juncture. There cannot be much improvement in the demand for nut and bolt iron while foreign competition obtains on the present scale. The cheapest local iron for bolt and nut work would not be under £9 2s. 6d.

Steel.

Although business is some branches of the steel trade remains quiet, general conditions are more active than of late. Irregularity in working is still a feature of the British steel industry, a lack of confidence being noticeable in the home market, and as a consequence buying is mostly restricted to small quantities for near delivery. The export demand has improved, and a good business is reported from the Far East in steel plates. At Sheffield there is a steady demand for basic billets, but Siemens acid billets continue to be in good request. Continental competition in the former is more acute, and prices are £1 or more below British prices. There are no alterations on last week's quotations. In the tinplate market makers' quotations are at 18s. 6d. to 19s. basis for coke tinplates, net cash, f.o.b. Welsh ports.

Scrap.

The depression now prevailing in the pig-iron industry has also extended to dealings in foundry-scrap material. Markets everywhere are very quiet, and at Middlesbrough this week only small parcels of ordinary heavy cast iron are saleable at 62s. 6d., though 66s. 6d. is still being paid for machinery quality. In Scotland, consumers generally have fairly heavy stocks in hand, and buying consequently is on a restricted scale. Quotations are practically unchanged, with machinery cast-iron scrap for foundries at 68s. 6d. to 70s. and 63s. 6d. to 65s. for ordinary cast iron of the usual specification. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Owing to the determined efforts of the American Copper Exporters to maintain prices at an artificial level of 18 cents per lb., buyers of warrant metal are holding off the market, and business is in greatly restricted volume. Values, however, remain very firm, and have shown practically no change during the past week.

Closing quotations are :—

Cash.—Thursday, £74 5s. to £74 10s.; Friday, £74 10s. to £74 15s.; Monday, £74 15s. to £75; Tuesday, £74 12s. 6d. to £74 15s.; Wednesday, £74 5s. to £74 10s.

Three Months.—Thursday, £69 7s. 6d. to £69 10s.; Friday, £69 12s. to £69 15s.; Monday, £69 17s. 6d. to £70; Tuesday, £69 17s. 6d. to £70; Wednesday, £69 12s. 6d. to £69 15s.

Tin.—The latest development of the scheme of the Tin Producers' Association to limit outputs appears to be making satisfactory progress, the January tin returns revealing that the increase in the visible supply was only 830 tons, whereas estimates of the increase had varied from 1,000 to 1,500 tons. Judging from the figures, it would appear that there has been a decline in output last month.

Official closing prices :—

Cash.—Thursday, £176 10s. to £176 12s. 6d.; Friday, £176 to £176 2s. 6d.; Monday, £175 5s. to £175 7s. 6d.; Tuesday, £174 15s. to £174 17s. 6d.; Wednesday, £174 7s. 6d. to £174 10s.

Three Months. — Thursday, £179 10s. to £179 12s. 6d.; Friday, £178 17s. 6d. to £179; Monday, £178 2s. 6d. to £178 5s.; Tuesday, £177 15s. to £177 17s. 6d.; Wednesday, £177 7s. 6d. to £177 10s.

Spelter.—Recently there has been a steady decline in values of ordinary spelter, the price at the end of January having advanced in response to the improved demand from consumers, who were replenishing their stocks, which in many cases had been considerably depleted. The cessation of this demand caused a reaction, which is responsible for the present weakness.

Daily quotations are :—

Ordinary.—Thursday, £19 11s. 3d.; Friday, £19 12s. 6d.; Monday, £19 13s. 9d.; Tuesday, £10 12s. 6d.; Wednesday, £19 13s. 9d.

Lead.—The market for this metal is still rather quiet. The trade demand is small, partly because it is believed that during the last few months there has been a considerable increase in stocks in private warehouses. Supplies of foreign pig-lead are well controlled on this side, and there seems no prospect of the market changing from its present level.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £21 12s. 6d.; Friday, £21 12s. 6d.; Monday, £21 12s. 6d.; Tuesday, £21 12s. 6d.; Wednesday, £21 13s. 9d.

Students' Corner.

Q.—Sometimes the metal immediately near the densener is hard and dense. What is the cause of that?

A.—The cause is due to the chilling effect of the densener on the molten metal. If the chilling effect is severe, probably the combined carbon has been increased just where the liquid metal meets the densener, and this would account for its hardness.

Q.—When this hardness occurs, what is the remedy?

A.—A less heavy densener should be used, and the metal poured at a higher temperature; one, or both, may reduce the hardness.

Q.—How many times may denseners be used?

A.—This depends largely upon circumstances. If they are properly preserved when not in work, they may be used several times. The surface should be examined in all cases before use.

Q.—What protective coating should be applied to denseners before use?

A.—A good quality dry blacklead (*i.e.*, graphite-carbon) should be rubbed on the surface by hand each time before using, oils and wet blackings should be avoided.

Q.—Why should oils and wet blackings be avoided?

A.—Oils generate gas when the fluid metal comes into contact with the densener. Wet blackings, when dried on the densener is liable to shell off during pouring.

Q.—What are the necessary precautions to be taken with denseners?

A.—(1) A green sand mould containing denseners should not be closed warm, (*i.e.*, whilst the sand is steaming); (2) Denseners when not in use should be stored in a dry place, preferably in, or near, a damp-proof store; (3) When a densener shows signs of wear (*i.e.*, small surface cracks), it should be scrapped, and (4) Impingement of the runner-gates against a densener should be avoided.

Why a densener should not be enclosed in a steamy sand mould will be apparent. The steam will condense as water on the densener, thereby causing "blowing." The sand will absorb the moisture which may do no harm, but the metal densener is not an absorbent of water. Hence the rapid expansion of moisture to steam. Why denseners should be stored in a dry place when not in use is to prevent rust forming on the surface. Rust contains combined water, which is liberated when pouring the casting. Molten iron coming into contact with rust is similar to putting a light to gunpowder.

The surface cracks developed in a densener through wear contain air, which expands when molten metal comes into contact. Impingement of a runner-gate against a densener not only heats it up, thus destroying its desired effect, but eats into the densener, and partially melts it away, thus destroying it.

If a densener is used in a casting enclosed with metal, and needs to be knocked out each time and used again, the surface should be perfectly smooth, as much taper as possible allowed, and driven out of the casting as soon as possible after pouring.

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COAL DUST.

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NETHERTON IRONWORKS, DUDLEY.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	74	5	0
Three months	69	12	6
Electrolytic	83	10	0
Tough	78	0	0
Best selected	78	10	0
Sheets	110	0	0
India	91	15	0
Wire bars	84	5	0
Do. Feb.	84	5	0
Do. March.	84	5	0
Ingot bars	84	5	0
H.C. wire rods	86	2	6
Off. av. cash, January	71	11	1 13/24
Do., 3 mths., January	69	0	2 1/24
Do., Sttlmnt., January	71	10	8 5/11
Do., Electro, January	83	10	9 9/11
Do., B.S., January	77	3	7 3/4
Do., wire bars, January	83	16	7 11/11
Aver. spot price, copper, Jan.	71	11	1 13/24
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11½d.

BRASS.

Solid drawn tubes	12¾d.
Brazed tubes	14½d.
Rods, drawn	12½d.
Rods, extd. or rlld.	7⅞d.
Sheets to 10 w.g.	11½d.
Wire	10⅞d.
Rolled metal	10⅜d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	174	7	6
Three months	177	7	6
English	175	10	0
Bars	177	15	0
Straits	176	17	6
Australian	175	15	0
Eastern	180	5	0
Banca	178	15	0
Off. av. cash, January	175	10	10 10/11
Do., 3 mths, January	178	15	2 5/11
Do., Sttlmt., January	175	10	5 5/11
Aver. spot, January	175	10	10 10/11

SPELTER.

	£	s.	d.
Ordinary	19	13	9
Remelted	18	0	0
Hard	16	5	0
Electro 99.9	21	15	0
English	20	0	0
India	17	15	0
Zinc dust (Nom.)	30	0	0
Zinc ashes	6	0	0
Off. aver., January	19	18	9
Aver., spot, January	19	12	8 1/22

LEAD.

	£	s.	d.
Soft foreign ppt.	21	13	9
English	23	0	0
Off. average, January	21	11	1 23/24
Average spot, January	21	10	10 10/11

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	29	0	0
Do. V.M. ex-whf.	27	0	0
Rods	33	0	0
Boiler plates	26	0	0
Battery plates	26	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	46	10	0
Chinese	31	0	0
Crude	18	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	23	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	17	6
45/50%	11	10	0
75%	19	0	0
Ferro-vanadium—			
35/50%	12/9 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbonless	9d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/1½ lb.		
Tungsten metal powder—			
98/99%	3/4½ lb.		
Ferro-chrome—			
2/4% car.	£30	7	6
4/6% car.	£23	7	6
6/8% car.	£22	10	0
8/10% car.	£22	2	0
Ferro-chrome—			
Max. 2% car.	£33	15	0
Max. 1% car.	£39	0	0
Max. 0.70% car.	£41	12	6
70% carbonless	11d. lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/6 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (net)—			
76/80% loose	£12	10	0
76/80% packed	£13	10	0
76/80% export	£12	15	0
Metallic manganese—			
94/96%, carbonless	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	6	0	to	3	7	6
Bundled steel and shrngs.	3	2	6	to	3	5	0
Mixed iron and steel	3	2	6	to	3	4	0
Heavy cast iron	2	18	6	to	3	0	0
Good machinery for foundries					3	2	6
Cleveland—							
Heavy steel					3	3	6
Steel turnings					2	16	6
Cast-iron borings					2	13	0
Heavy forge					3	15	0
W.I. piling scrap					3	10	0
Cast-iron scrap	3	2	6	to	3	6	6
Midlands—							
Ord. cast-iron scrap					3	5	0
Heavy wrought					3	17	6
Steel turnings	2	5	0	to	2	7	6
Scotland—							
Heavy steel					3	7	6
Cast-iron borings					2	10	0
Wrought-iron piling					4	0	0
Heavy machinery					3	10	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	61	0	0
Brass	43	0	0
Lead (less usual draft)	20	0	0
Tea lead	16	0	0
Zinc	13	0	0
New aluminium cuttings	65	0	0
Braziery copper	57	0	0
Gunmetal	54	0	0
Hollow pewter	130	0	0
Shaped black pewter	97	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	78/6
Hematite M/Nos.	78/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/-
,, d/d Birm.	95/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	74/6
,, No. 3 fdry.*	78/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	80/6
,, No. 3	78/-
Hem. M/Nos.	81/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge.	73/6
,, fdry No. 3	77/6
E.C. hematite	89/-
W.C. hematite	91/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.) nom.					10	15	0
Nut and bolt iron	9	2	6	to	9	7	6
Hoops	10	15	0	to	11	5	0
Marked bars (Staffs) f.o t.					12	10	0
Gas strip	10	15	0	to	11	5	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	15	0	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					8	2	6
					and upwards		
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates	12	0	0	to	12	10	0
Hoops (Staffs)	9	10	0	to	9	15	0
Black sheets, 24 g.					9	15	0
Galv.cor.shts., 24g.	11	15	0	to	12	0	0
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft	6	2	6	to	6	12	6
Billets, hard	7	10	0	to	8	0	0
Sheet bars	5	17	6	to	6	5	0
Tin bars	5	17	6	to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.76
No. 2 foundry, Valley	18 50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y, at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.90
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.60
Sheets, galv., No. 24	3.30
Sheets, blue an'l'd, No. 13	2.25
Wire nails	2.30
Plain wire	2.40
Barbed wire, galv.	2.95
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	30/- to 35/-
,, furnace	30/- to 32/-
Durham and Northumberland—	
,, foundry	17/- to 17/6
,, furnace	19/- to 19/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		18/9
,,	28×20 ,,		37/-
,,	20×10 ,,		26/6
,,	18¾×14 ,,		19/3
C.W.	20×14 ,,		16/-
,,	28×20 ,,		34/3
,,	20×10 ,,		23/6
,,	18¾×14 ,,		17/-
Terneplates	28×20		32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water	61¼%	42½%
Steam	57½%	37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Feb.	6	..	74	5	0	inc.	27/6
,,	7	..	74	10	0	,,	5/–
,,	10	..	74	15	0	,,	5/–
,,	11	..	74	12	6	dec.	2/6
,,	12	..	74	5	0	,,	7/6

Electrolytic Copper.

			£	s.	d.												
Feb.	6	..	83	10	0	No	change	Feb.	6	..	178	0	0	No	change	Feb.	6	..	19	11	3	No	change
,,	7	..	83	10	0	,,	,,	,,	7	..	177	0	0	dec.	20/–	,,	7	..	19	12	6	inc.	1/3
,,	10	..	83	10	0	,,	,,	,,	10	..	176	5	0	,,	15/–	,,	10	..	19	13	9	,,	1/3
,,	11	..	83	10	0	,,	,,	,,	11	..	175	15	0	,,	10/–	,,	11	..	19	12	6	dec.	1/3
,,	12	..	83	10	0	,,	,,	,,	12	..	175	10	0	,,	5/–	,,	12	..	19	13	9	inc.	1/3

Standard Tin (cash).

			£	s.	d.		
Feb.	6	..	176	10	0	dec.	7/6
,,	7	..	176	0	0	,,	10/–
,,	10	..	175	5	0	,,	15/–
,,	11	..	174	15	0	,,	10/–
,,	12	..	174	7	6	,,	7/6

Tin (English ingots).

			£	s.	d.												
Feb.	6	..	178	0	0	No	change	Feb.	6	..	29	0	0	dec.	20/–	Feb.	6	..	23	0	0	No	change
,,	7	..	177	0	0	dec.	20/–	,,	7	..	29	0	0	No	change	,,	7	..	23	0	0	,,	,,
,,	10	..	176	5	0	,,	15/–	,,	10	..	29	0	0	,,	,,	,,	10	..	23	0	0	,,	,,
,,	11	..	175	15	0	,,	10/–	,,	11	..	29	0	0	,,	,,	,,	11	..	23	0	0	,,	,,
,,	12	..	175	10	0	,,	5/–	,,	12	..	29	0	0	,,	,,	,,	12	..	23	0	0	,,	,,

Zinc Sheets (English).

Spelter (ordinary).

Lead (English).

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

——	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	6 0 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 3 9
1898	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 5 0	6 5 0	6 10 0	6 10 0	6 2 11
1899	3 10 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 10 0	7 10 0	8 10 0	9 0 0	9 0 0	9 10 0	7 12 11
1900	10 0 0	10 10 0	10 10 0	10 10 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	9 10 0	8 15 0	8 15 0	10 1 3
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8½
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 3 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2½
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 12 6	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7½	9 15 2½
1930	10 7 6	—	—	—	—	—	—	—	—	—	—	—	—

* No quotations available owing to strike.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

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ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRYMAN (young) desires position as Manager, Foreman, or Representative; practical, technical and commercial ability; speciality cylinders; part-time job considered; excellent testimonials.—Box 430, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BRASS Foundry Foreman.—First-class man with some metallurgical training, to take charge of modern foundry engaged on varied class of work, including Admiralty contracts.—Apply in confidence, stating age, full details of experience, and remuneration required, to Box 434, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

LONDON Foundry requires Assistant Foreman; loam moulder.—Apply, stating age and experience, to Box 432, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

NON-FERROUS Metal Foundry in London requires the services of a young man to take charge of control and development work. A sound metallurgical training and some practical experience essential. Commencing salary £350. A progressive position for the right man.—Apply, Box 436, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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11 ACRES WORKS SITE.
SHEFFIELD.
145,000 Sq. Ft. of SHOPPING,
Compact and Convenient.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PATENT.

THE Proprietor of the Patent No. 163543 for Improvements in Rotary Furnaces is desirous of entering into arrangements by way of licence or otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY.

THWAITES' No. 3 Cupola, drop bottom, receiver; No. 2 Belt-driven Roots' Blower, piping escape valve; 10-cwt. Cage Hoist with staging for cupola.—Further particulars, write J. BURGOINE & SONS, LIMITED, Croft Street, Bury, Lancs.

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

EIGHT 2-ton All-Steel Overhead Travelling Cranes, hand-operated by chains from floor. Makers, Herbert Morris, Limited. Hoisting, travelling, traversing. In new condition. Span 14 ft. 6 in. Price £20 each, f.o.r. Stoke-on-Trent.—CHARLES JONES, Weston Coyney, Stoke-on-Trent.

MACHINERY—*Continued.*

"M.R.V." 440-lb. TILTING FURNACES, coke fired, by M.R.V. Furnaces Company, Birmingham.

Richmond Gas-fired MUFFLE FURNACE, hearth 3 ft. 6 in. long x 2 ft. 6 in. wide x 12 in. high, by Richmond Gas Stove Company, Limited, Warrington.

Tilghman AIR COMPRESSOR, with automatic unloader, capacity 130 cub. ft. per min. at 30 lbs. pressure.

Single-stage Axial Type AIR COMPRESSOR, by Reavell, capacity 100 cub. ft. of air per min. at 30 lbs. pressure.

CRANE COREBOX-MAKING MACHINE.

Oliver No. 77 Pattern-shop Universal BORING MACHINE, with foot-controlled motion and Horizontal Boring Attachment.

Sagar Double-Spindle Vertical MOULDING MACHINE, table 4 ft. 0 in. x 3 ft. 1 in.

DAVID BROWN & SONS (HUDDERSFIELD), LIMITED,
Park Gear Works, Huddersfield.

No. 3 22-in. x 48-in. CHURCHILL Internal Cylinder Grinder, for loco. cylinders.

NEW "DEUTSCHE NILES" Vertical Boring and Turning Mill, with side head, capacity with side head 41⅜ in., without side head 47 in. dia.

NEW "BLANCHARD" Type Vertical Surface Grinder, with 19½ in. dia. chuck.

No. 60 HEALD Internal Grinder, with planetary head.

CONCRETE MIXERS, Belt-, Steam-, and Petrol-driven, from 3 cub. ft. to 1 cub. yd. capacity, by Ransome, Stothert & Pitt, Millars, etc.

HORIZONTAL DOUBLE-GEARED STEAM WINCHES, 4½ in. x 6 in. stroke to 10 in. x 15 in. stroke, suitable for hauling.

FOUNDRY LADLES, various types and sizes.

Five VERTICAL COCHRAN BOILERS, 17 ft. 0 in. x 8 ft. 6 in., re-insure for 100 lbs. pressure.

16,000 ft. 1½-in. New Black Steel Screwed and Socketed Piping in lengths of 18 ft. and upwards.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

NEW "Badische" Reversing Rumbling Barrel, 48 in. x 60 in., complete with Vertical Electric Motor, 220 D.C.; especially strongly built, suitable for iron or steel castings; price, delivered, £320; also new "Badische" Portable Centrifugal Sand Sifting and Throwing Machine, complete with 220 D.C. Motor; price £62 10s. delivered. Immediate delivery from London stock.—Box 426, Office of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

NON-FERROUS CASTINGS. — Inquiries solicited from the Trade. Prompt attention; first-class products; reasonable prices.—PRECISION CASTINGS, LIMITED, Lincoln Street, Wolverhampton.

"PURIC" CUPOLA FLUX in Block Form cleanses and desulphurises all cupola mixtures. No increase in cost of mixtures, but actual saving obtained, owing to the production of better metal and owing to less wear on the furnace linings.

Over 600 foundries have testified to the advantage of using "Puric." Send for trial cwt.—Write, BEECROFT & PARTNERS, LIMITED, The Foundry Chemists, Retort Works, Mappin Street, Sheffield.

Foundry Consultants and Advisors. Analyses and Testing carried out at low rates at The Laboratories, St. Peter's Close, Sheffield.

MISCELLANEOUS—*Continued.*

GANISTER, best quality for cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

FLUORSPAR. — The Ideal Flux for all Foundry and Furnace work; supplied in crude lump, washed gravel or finely ground. Samples and prices from

A. BECK,
MINEOWNER, MATLOCK.

'Phone: 287 SLOUGH

LADLES.

10 Ton **McNeil,** new	£46
8 Ton **EVANS,** new	£42
5 Ton **STEVENSON** as new ...	£34
1 Ton new with totally enclosed gear	£18
½ Ton, ungeared	£7

HANDSHANKS—ALL SIZES—CHEAP

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS.

BUY FROM ME AND SAVE MONEY

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND
(FOUNDED 1838)
SWISS COTTAGE, LONDON, N.W.3

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